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SOME QUANTITATIVE ASPECTS OF FATIGUE OF MATERIALS

Harold N. Cummings

Curtiss-Wright Corporation, Propeller Division
Caldwell, New Jersey

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JULY 1960

WRIGHT AIR DEVELOPMENT DIVISION

NOTICES

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Materials Central
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WRIGHT AIR DEVELOPMENT DIVISION
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FOREWORD

This report was prepared by Curtiss-Wright Corporation, Propeller Division, under USAF Contract No. AF 33(616)-6552. This contract was initiated under Project No. 7381, "Materials Applications", Task No. 73810, "Exploratory Design and Prototype Development." The work was administered under the direction of the Materials Central, Directorate of Advanced Systems Technology, Wright Air Development Division, with Mr. K. D. Shimmin acting as project engineer.

This report covers work conducted from May 1959 to April 1960.

The interest and suggestions of Messrs. J. M. Mergen, Director of Engineering, F. B. Stulen, Assistant Chief Engineer, Analysis, and W. C. Schulte, Chief Metallurgist, at Curtiss-Wright Corporation, Propeller Division, are gratefully acknowledged.

ABSTRACT

In this report are given not only the fatigue properties of many structural materials but also the "static" properties and such other supplementary information as was given in the references consulted. The data are in general from room temperature tests, but a few data are given on tests at higher temperatures. The data are presented in tables and on curves, supplemented by brief discussions in the text.

PUBLICATION REVIEW

This report has been reviewed and is approved.

FOR THE COMMANDER:

W. J. Trapp

W. J. TRAPP
Chief, Strength and Dynamics Branch
Metals and Ceramics Laboratory
Materials Central

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SECTION I. INTRODUCTION

1.1 Purpose of This Report

The purpose of this report is to provide research and design engineers and metallurgists with, as nearly as possible, complete data as to the "room temperature" fatigue properties of structural materials, and a few high temperature properties, as determined in the laboratory. Also, since these properties can be so radically changed by so many different variables, as discussed in ref. (1)2/, the report presents for each item all of the special conditions under which its reported fatigue properties hold good as far as they are stated in the references.

The values of fatigue strength for a specified cycle life, listed under S_e in the tables, must of course be understood to be an average or median value. In other words, only about one-half of the specimens tested had as much strength, and the other half showed less than the tabulated strength. In the few cases in which a value of the "standard deviation" is given, some extrapolation downward may be justifiable, but it must be done cautiously. Reference (2) should be consulted for a discussion of the statistical analysis of fatigue data.

1.2 The Format of The Report

The information gathered from the references is presented in tables, figures and brief discussions. Each individual value of Se is given a line in the proper table, and an "Item" number in the table. In these tables, the data for each item begin on the left hand page, and are continued on the right hand page, on which the item numbers are repeated. Information not covered by the topics in the tables is given in the brief discussions to be found in Sections II to VII and on the figures referred to in the discussions. A list of the materials, with Table, Paragraph, and Figure numbers, is given at the back of the report.

1.3 Notation

A	Ratio of Alternating to Steady Stress
AC	Air Cool
cpm	Cycles per minute
Elong.	Elongation (Static)
FC	Furnace Cool
Ht.	Heat
ksi	Thousands of psi
K_t	Geometric (Theoretical) Stress Concentration Factor
OQ	Oil Quench
R'	Ratio of Minimum to Maximum Stress
R	Root Radius of Notch
R.A.	Reduction of Area (Static)
RAT	Reduction of Area, Transverse
R.T.	Room Temperature
Se	Fatigue Strength, Fully Reversed Stress, for Indicated Number of Life Cycles
S_m	Mean (Steady) Stress
St. Dev.	Standard Deviation of Fatigue Strength
UTS	Ultimate Tensile Strength (Static)
WC	Water Cool
YP	Yield Point (Static)

1/ Manuscript released by the author March 31, 1960 for publication as a WADD Report.

2/ Numbers in parentheses refer to the Bibliography.

SECTION II. STEELS

2.1 General

Steels given SAE or AISI numbers are placed in Tables I to III. Other steels, in general, are listed as Special Steels and will be found in Table IV. These are steels designed by the steel-makers, usually for various specific fields of application. Stainless steels, however, have been classified as Heat Resistant Alloys and listed in Table V, since they offer considerable resistance to corrosion under high temperature conditions.

The long-life ($N = 10^7$) fatigue strength of smooth steel specimens, and also of specimens notched with theoretical stress concentration factors anywhere from 2.0 to 4.0, have been plotted on Fig. 1. Steels that have been carburized or nitrided are not plotted on the figure.

2.2 Discussion of Data in Tables I to IV

2.2.1 SAE Steels 1008 to 4335

Items 1-3 Ref. 3

These tests on SAE 1008 steel were run primarily to see if lowe[illegible] the carbon content nearly to the vanishing point would lower, or eliminat[illegible]e "fatigue limit" of the iron. Fig. 2 shows the S-N curves for the 1008 st[illegible] before and after decarburizing. It must be pointed out that the effect sh[illegible] on this very low carbon steel cannot be extrapolated to predict the results of partial decarburization of modern high strength steels.

Items 4-5 Ref. 4

The 1020 steel was "hot-rolled bar stock . . . of electric melted steel". S-N curves are given on Fig. 3.

Items 6-23 Ref. 5

In this series of tests the "cast steels were supplied in coupon form, the wrought steels in the form of hot-rolled stock". Eight to eleven specimens were tested for each S-N curve. The tests were primarily to study the relative merits of cast and wrought steels. For the materials tested the authors conclude that "there is no advantage of one material over the other at either small or large numbers of cycles when critically shaped notches are present in steels tested in fatigue". Figs. 4 to 7 give S-N curves for the 1040 steel. (See also data on 4135, 4140, 8630 and 8640 steels).

Items 24-30 Ref. 6

Material is Smooth 2315 Steel. Specimens were carburized to a depth of 0.041" to 0.044". Fig. 8 shows S-N curves. These studies were made in connection with studies of the fatigue of full-scale rear-axle automobile gears. The gears failed at fatigue strengths, or lives, much less than the tests predicted, therefore the authors of reference 6 concluded that stress concentrations due to designs or machining marks, etc., were more responsible for the failures than the choice of one steel rather than another of those studied. NOTE: There is no particular significance in the fact that "Item 30" is in the same block as Item 27, on Fig. 8.

Items 31-33 Ref. 6

Material is Notched 2315 Steel. A peculiar design for notched R. R. Moore specimens was used. The design is shown in Fig. 9. Authors of ref. 6

say: "Stresses . . . were calculated at the surface opposite the notch. Because of the shape of the cross-section through the notch, this point is more highly stressed than in the center of the notch. Failure starts, however, at the intersection of the bottom of the notch with the surface where the stress is apparently highest. No method is known for calculating stress at that point; therefore, the value obtained for the surface opposite the notch was used in plotting curves". In the "Discussion", R. E. Peterson says: "An Approximation can be obtained by means of the Neuber solution, reference 7, which gives a stress concentration factor of 3.14 for the two-dimensional case and 3.47 for the three-dimensional case". S-N curves are given in Fig. 10.

Items 34-37 Ref. 6

Material is Smooth 2330 Steel for Items 34-36 and Notched 2330 Steel for Item 37. See Items 24 to 33 above for general discussion. S-N curves for Smooth Carburized 2330 are shown in Fig. 11. S-N curve for Notched Carburized 2330 is shown in Fig. 12.

Items 38-39 Ref. 8

The "endurance limits" for this SAE 2340 steel were obtained from a few specimens. The reference shows an S-N curve, Fig. 13, for notched specimens only, based on eight specimens.

Items 40-44 Ref. 10

For this SAE 4130 steel, approximate S-N curves for fully reversed stressing, plotted from data in the reference, are given in Fig. 14. Fig. 15 shows the effect of mean (steady) stresses superimposed on the alternating stresses. In general, the S-N curves upon which these items depend were each based on from five to ten or fifteen specimens.

Items 45-52 Ref. 5

Discussion of Items 6-23 applies also to these items on 4135 and 4140 steel.

Item 53 Ref. 11

Etching showed the grain flow of this 4320 steel to be transverse to the axis of the specimens. Static properties are given as determined at Wright Field "Tested transverse to the direction of rolling". Fig. 16 shows the S-N curve as traced from the reference report.

Items 54-59 Ref. 12

Thest tests show the nitrided notch strength to be about triple the unnitrided notch strength for this 4320 steel. Comparison of Items 56 and 55, or 59 and 58, indicates that increasing the time of nitriding from 8 to 15 hours increased the long life fatigue strength of the specimens tested by about 15 percent.

Items 60-67 Ref. 13

Most of the data for static properties of this 4330 steel and all data for fatigue properties were scaled from various charts in the reference report. The material is described as "hot rolled from commercial, electric-furnace heats". The S-N curves taken from the report are given on Figs. 17-21.

Items 68-73 Ref. 14

These six values of S_e for 4330 steel indicate variations among three different heats of steel, and between longitudinal and transverse specimens of each heat. The reference gives 95% confidence limits for each S_e, amounting to from 1.6 to 4.4 ksi. These tests were made by the Prot method which theoretically gives S_e for infinite life. Static properties are averaged from tests of two to four specimens. The small differences among them are probably not as significant as they appear to be.

Items 74-77 Ref. 5

Discussion of Items 6-23 applies also to these items on 4335 steel.

2.2.2 SAE Steels 4340 and 4350

Items 1, 2 Refs. 15,16

It should be noted that by changing the heat treatment the item 2 steel was given a different microstructure and a reduced tensile strength. It may be presumed that this accounts for the reduced fatigue strength of the item 2 steel. The method of computing stresses as reported in reference 15 was reviewed in reference 16 and certain inaccuracies pointed out. The stresses reported herein are based on the findings of reference 16, both in the data tables and on the S-N curves, Figs. 22 and 23.

The S-N curves, Figs. 22 and 23, show the statistical variability of the two steels. Note that the finite life variability was obtained by analyzing constant-stress data, whereas the endurance limit variability was obtained by analyzing constant-life data. A large number of specimens was used for these studies, which gives a high degree of confidence to the results, for the type of specimen used and the manner of testing. The "endurance limits" for these items may be presumed to be lower than would have been obtained if the specimens had been "round, rotating" instead of "rectangular-cantilever". (See Figs. 14, 15, 16 of reference 23). The implication of the report, reference 15, is that inclusions rather than surface finish, determined fatigue strength. (Surface finish is not reported for these specimens.).

Items 3-12 Ref. 17

The reference reports a size-effect study on specimens of SAE 4340 steel for sizes from 1/8 inch to 1 3/4 inch diameter. There is an implied conclusion in the reference that size effect is extremely small, in case of extrapolating from test results on specimens in the neighborhood of 2" diam. to specimens of greater size.

Considerable variability appears in the detailed data of this reference. The authors of the reference believe it to be due, at least to a considerable degree, to non-uniformity both transversely and longitudinally in metallurgical structure of the 3" diameter bars used as source material. (Photomicrographs show pronounced bending in some of the longitudinal sections.) This is thought, by the authors, to account for the disproportionally low endurance limit of the notched 1 3/4" diameter specimens.

Fig. 24 shows S-N curves from the reference report. Each of the curves, as shown, is based on only about a dozen test specimens.

Items 13-16 Refs. 18,19,20

Fig. 25 based on reference 20, shows individual S-N curves for fully reversed axial tests on four hardnesses of the steel. The curves for smooth specimens were derived by extrapolation from tests on notched specimens. The two curves for the 190 ksi UTS steel represent specimens from different bars.

Twelve specimens were tested for each S-N curve on Fig. 25.

Items 17-20 Ref. 21

These steels are called SAE 4340 but they are somewhat low in carbon, particularly items 19 and 20. This fact should be taken into account in considering either the static or the fatigue strengths, both of which might have been a little higher if the carbon had been chosen to the usual 4340 specifications.

It is to be noted that two heats of steel were used, each hardened to about the same static strength as the other. However, one of the heats (items 17 and 18) showed low ductility in the direction transverse to forging, and correspondingly low fatigue strength in the transverse direction. This heat also showed more variability in the transverse tests than in the longitudinal tests.

Each value of S_e in the data table is based on a staircase test of about 50 specimens. The S-N curves, Figs. 26 and 27, were obtained by combining the staircase (2) test results with the results, in each case, of about 15 additional specimens tested at constant stress. The 2 σ curves show scatter in finite life. Scatter in long-life strength, shown in the data table, was determined from the staircase tests.

Items 21-26 Ref. 22

In this report on high temperature fatigue tests, a considerable amount of data were obtained on 4340 steel at room temperature. These data are presented herein. The discovery of a few unusually large inclusions led to considerable study of the cleanliness of SAE 4340 steel. "Micro-examination of the specimens made by the metallurgical laboratory of the Republic Steel Corporation revealed some fine dispersed globular non-metallic inclusions throughout the matrix of the steel. . . . . the inclusions proved to be carborundum crystals with silicate glass, . . . which is probably a deoxidation product rather than a product of refractory erosion. . . . Check tests with supposedly clean material, submitted by Republic Steel Corporation especially for this purpose, revealed negligible influence in this respect. However, in a few specimens of this material, submitted by Republic Steel Corporation, small inclusions of the same appearance were found, which may indicate that the SAE 4340 steel in general is permeated by this composition".

S-N curves, Figs. 28 and 29, give information regarding items 21, 23, 24 and 26. Data for items 22 and 25 were obtained from tests run at "zero to maximum tension". In such tests, the mean (steady) stress varies continuously throughout the S-N curve, so that a curve of the type of those on Fig. 29 cannot be drawn. Alternating stress-steady stress diagrams (modified Goodman diagrams) are given for both smooth and notched specimens on Fig. 30.

Items 27, 28 Ref. 23

Fig. 31 shows the "control" S-N curves for 4340 steel obtained by the authors of reference 23 incidental to the main purpose of their tests, which were studies of the effect of varying amplitude.

Items 29-39 Ref. 24

Fig. 32 shows results of tests of 4340 steel, especially at high stress levels. Heating effects shortened life of high stress level specimens so seriously that cpm were reduced, for them, from 3450 to 90.

Note that curves for items 38 and 39 show alternating stresses only, and that for any value shown on these curves there was also a steady stress of

magnitude equal to the maximum tensile alternating component; - in other words, the tests were "pulsating", i.e., zero to tension.

Fig. 33 shows mean "endurance limits" increasing linearly with UTS, up to 220 ksi UTS. For higher tensile strengths the "endurance limits" have, in general, been found to increase at a slower rate for this steel.

Item 40 Ref. 25

The 4340 steel was taken from two propeller shanks. Reference states that statistical studies show no significant difference in the strength of the two shanks, therefore, the data from the two shanks were combined.

From Tables II and III, p. 887 of the reference, data were taken, and analyzed by the Step Method (reference 2), which gave the mean endurance limit at 10^7 cycles as 86 ksi, and the standard deviation from the mean as 8.0 ksi, for this steel which had been heat-treated to about 160 ksi UTS.

Items 41-56 Ref. 26

The S-N curves for 4340 steel shown on Figs. 34, 35, were "drawn separately by inspection in order to represent the trend of the data".

The effect of steady stress, as shown in the reference, is shown on Figs. 36, 37. Of course, stresses plotted to the right of the yield-point boundary are more of the nature of modulus-of-rupture points, since the nominal formula used for calculating them (Mc/I) does not apply in the plastic region. Note that torsional steady stress, according to Fig. 37, appears to have only a slight effect on torsional alternating stress.

Items 57-62 Refs. 27,28

S-N curves for 4340 steel are shown on Figs. 38,39,40. At least 280 specimens were used in determining each of the six S-N curves on these figures. Between 170 and 200 additional specimens were tested and the results used in determining the values of S_e for each of the items 57, 59, and 61. This gives an unusual degree of reliability to these values of S_e, but only for the single heat from which all of the specimens were taken.

Items 63-67 Ref. 29

The S-N curves for 4340 steel, for items 63 and 64, appear on Fig. 41. Two hundred or more specimens were used for each of the S-N curves. The tests were made to "investigate the actual fatigue behavior of SAE 4340 steel in what has been reported to be a brittle range". The reference states that "the reported brittleness of the 230 ksi UTS steel tested is perhaps not so serious as had been thought".

For items 65 and 66, the S-N curves are given on Fig. 42. About 450 specimens of vacuum melted steel were tested for each of the curves. Attention is called, in the reference, to the fact that "the notches cut in the 'notched' vacuum melted specimens reduced the life and strength of the steel to practically the same values previously found for the air-melted steel".

The steel used for item 67 was made by the consumable electrode method. Only 20 specimens were tested and the reference suggests that the value of S_e as determined by an abbreviation of the Prot method is subject to some uncertainty.

Items 68-71 Ref. 30

These tests of the transverse fatigue properties of SAE 4340 steel were made on steel from the same heat that was used for items 57-72. The purpose

was to investigate the relative effect of non-malleable spheroidal inclusions on transverse as compared with longitudinal specimens. The reference concludes that "the non-malleable inclusions in the present steels are not important causes of anisotropy". S-N curves for the four different hardnesses are given in Figs. 43 to 46.

Items 72-75 Ref. 5

These items show the effect of different heat treatments on smooth and notched 4340 steel.

Items 76-85 Ref. 14

These ten values of S_e for 4340 steel indicate variations among five different heats of steel, and between longitudinal and transverse specimens of each heat. The reference gives 95% confidence limits for each S_e, amounting to from 2.0 to 3.8 ksi. These tests were made by the Prot method, which theoretically gives S_e for infinite life. Static properties are averaged from tests of two to four specimens. The small differences among them are probably not as significant as they appear.

Items 86-87 Ref. 29

The S-N curves for this 4350 steel, shown on Fig. 47, are based on about 250 smooth and 250 notched specimens.

Items 88-95 Ref. 14

These eight values of S_e for 4350 steel indicate variations among four different heats of steel, and between longitudinal and transverse specimens of each heat. The reference gives 95% confidence limits for each S_e, amounting to from 3.5 to 4.5 ksi. These tests were made by the Prot method which theoretically gives S_e for infinite life. Static properties are averaged from tests of two to four specimens. The small differences among them are probably not as significant as they appear to be.

2.2.3 SAE Steels 52100 to 98B40

Items 1-22 Ref. 32

Each S-N curve of the 22 that are shown on Figs. 48 and 49 was drawn to represent either 7 or 8 specimens. There is not enough information to warrant any assumption as to the variances of the "fatigue strengths" listed in Table III. (The fatigue strengths are given as listed in the reference report.) Tentative conclusions, as to the effect of various degrees of gentleness in surface finishing, as shown in the table below, are drawn in the report, but it is shown that the differences are so small in many cases that they may not be significant. Much greater differences occur, in general, between the tests of round and of flat specimens of the same material. In addition to the effect of shape, there may be some small difference chargeable to the difference in the speeds of testing round and flat specimens.

Surface Treatment of Specimens Tested for Figs. 48, 49

Item	Surface Treatment	Type	No. of Specimens
1	Gentle grind & shot peen	Round	8
2	Gentle grind	"	7
3	Gentle grind & tumble	"	4
4	Dry grind	"	8
5	Gentle grind & hand polish & heat treat.	"	7
6	Gentle grind & hand polish	"	7

Surface Treatment of Specimens Tested for Figs. 48, 49 (Continued)

Item	Surface Treatment	Type	No. of Specimens
7	Gentle grind	Flat	8
8	Gentle grind & hand polish	"	8
9	Severe grind	"	8
10	Severe grind & hand polish	"	8
11	Gentle grind & hand polish	Round	7
12	Gentle grind & tumble	"	7
13	Gentle grind & shot peen	"	7
14	Gentle grind	"	8
15	Gentle grind & hand polish & heat treat.	"	6
16	Gentle grind & grit blast	"	7
17	Severe grind & shot peen	Flat	8
18	Gentle grind & shot peen	"	8
19	Severe grind & tumble	"	8
20	Gentle grind	"	8
21	Gentle grind & electropolish	"	8
22	Severe grind	"	8

Items 23-26 Ref. 32

The four sets of specimens were cut from a tube of 3 5/8" O.D. and 5/8" I.D., so that Items 23 and 25 were from the bore of the tube and Items 24 and 26 were from the outside of the tube.

Items 27-32 Ref. 33

A comprehensive study by Styri on 52100 steel. Particular attention is given to the apparent lack of an endurance limit for this steel in the high hardness state, $\geqq$ Rc 60, - and to the very considerable scatter in the test results. Fig. 50 shows tests apparently comparable with R. R. Moore rotating cantilever tests. Size of specimens is not stated. A supplementary set of tests was run on a special (vacuum) melt of 52100 to see if the size of inclusions affected the degree of scatter. "A wide scatter appears here also, in spite of the great reduction in size of foreign inclusions".

Items 33-40 Ref. 5

The discussion of Items 6-23 in paragraph 2.2.1 applies also to these items on 8630 and 8640 steel. S-N curves for cast 8630 steel are given in Figs. 51 and 52, and for wrought 8640 steel in Figs. 53 and 54.

Items 41-42 Ref. 8

In the case of the boron steel 14B50, the reference shows an S-N curve, Fig. 55, for smooth specimens only.

Items 43-52 Ref. 13

For the data in Table III on this boron steel, 98B40, values were scaled from graphs in the reference report. Figs. 56-60 show the S-N curves as given in the report.

2.2.4 Special Steels

Items 1-6 Ref. 34

S-N curves for these tests of Tricent Steel (now called 300-M) are given on Fig. 61. Also on the figure are the curves for notched specimens of K_t = 3, 5, and 8. The S-N curves appear in the reference up to 10^6 cycles only, but as they are drawn it is reasonable to assume they would not show much decrease in values of S_e if they had been carried out to 10^7 cycles.

Items 7-9 Ref. 29

The two items 7 and 8 on Tricent-Steel apply to steel of about the same tensile strength as that of item 1. There is about 15 percent difference between values of S_e for these items and that of item 1. Attention should be given to the many differences between the conditions of heat treatment, testing procedures, etc., in attempting to account for the differences in fatigue strength.

Item 9, Super Hy-Tuf, was tempered at the same temperature as was Item 5, but was partially stress relieved (300°F). However, it has about the same fatigue strength as item 5.

Items 10-13 Ref. 34

S-N curves for these steels are given on Figs. 62 and 63 for both smooth and notched specimens.

Items 14-17 Ref. 13

Data for the Hy-Tuf and Super Hy-Tuf steels were scaled from charts in the reference. S-N curves are given in Figs. 64-65.

3.1 General

Many of the fatigue strength values given in Table V for these heat resistant alloys are the room temperature strengths of materials that had been prepared for high temperature testing. The term "Heat Resistant" is not well defined, and the inclusion of such alloys as are listed in Table V is rather arbitrary. Items 64 to 74 of Table XII, 67 to 86 of Table XIII, and 51 to 63 of Table XIV might have been included in Table V.

3.2 Discussion of Data in Table V

Items 1-4 Ref. 35

The effect of nitriding this Ferrovac WB-49 steel is shown graphically on Fig. 66. Notched fatigue strength is considerably increased by the nitriding.

Items 5-6 Ref. 36

The fatigue data for this GMR-235 "high temperature" alloy given in Table V are room temperature fatigue properties of a material that had been prepared for testing at temperatures of 1200°F and 1650°F. Room temperature S-N curves are given on Fig. 67 together with two other alloys.

Item 7 Ref. 37

For Halmo tool steel the reference gives a small S-N curve indicating that the fatigue strength at 10^8 cycles is appreciably lower than at 10^7 cycles. The curve is based on about a dozen and a half specimens.

Items 8-9 Ref. 36

Comments on items 5-6, above, apply to this Hastelloy R-235 alloy. See Fig. 67 for S-N curve.

Items 10-11 Ref. 38

S-N curves for H-11 alloy bar steel are given on Fig. 68. Special attention should be given to the scale of stresses on this figure. They show the combination of steady and alternating stresses at the various stress levels. Note that as steady stresses increase, the alternating stresses also increase.

Item 12 Ref. 35

An S-N curve for this H-23 steel, based on 107 specimens, is given on Fig. 69.

Items 13-14 Refs. 39, 38

The data on Inconel X come from two references. Regarding item 13, the authors of reference 39 made "exploratory tests on several" heat resistant materials (S-816, Inconel X, Type 403, TP-2B, TP-2-R). For each of the room temperature S-N curves on Fig. 70, they used five or six specimens. They say:- "Although the scatter in the fatigue data is generally relatively small, these data must be considered only approximate since so few specimens were used for each curve".

The S-N curve for Inconel X, derived from reference 38, shows a combination of steady and alternating stresses on Fig. 71.

Items 15-16 Ref. 40

Values of S_e for the Inconel X-550 were scaled from the S-N curves on Fig. 72.

Items 17-26 Ref. 41

These items give high temperature (1700°F) data on cast Inconel 713C. The S-N curves, Figs. 73, 74, were derived from figures given in the reference. Whereas the reference figures show crest stresses (steady plus alternating), Figs. 73, 74 show the separate components of crest stress. Notice that there are two scales on Fig. 73, one for the lower pair of curves which show the effect on reversed stresses at 1700°F, the other scale for the upper pair of curves which show the effect (creep) of a steady stress only ($A = 0$).

Item 27 Ref. 42

S-N curves for Lapalloy, and two other alloys for comparison, are given on Fig. 75. Note that each curve is based on a small number of specimens.

Item 28 Ref. 37

For M-1 steel the reference gives a small S-N curve indicating that the fatigue strength at 10^8 cycles is appreciably lower than at 10^7 cycles. The curve is based on about a dozen and a half specimens.

Item 29 Ref. 37

For MV-1 steel, the comment above in item 28 applies.

Items 30-33 Ref. 35

The M-10 steel, whose S-N curves are given in Fig. 76, shows considerably more improvement in notched fatigue strength after nitriding than is shown in the WB-49 steel (Items 1-4).

Items 34-35 Ref. 43

S-N curves, based on five or six specimens each, for the N-155 alloy are given on Fig. 70. The authors of the reference say:- "Since only a small number of points were obtained for each curve, the diagrams presented are only approximate".

Items 36-37 Ref. 38

The S-N curves, Fig. 77, for PH 15-7 Mo Stainless Steel show the combined steady and alternating stress separately on the scale of stresses. Note that the steady stresses increased as the alternating stresses increased.

Items 38-39 Ref. 38

Comments on items 36-37, above, apply to Fig. 78 for 17-7 PH steel.

Items 40-45 Ref. 44

Although it may appear that the change in grain size of this Refractalloy 26 is responsible for the sharp decrease in long-life strength

of the smooth specimens, the author of the reference points out that "the two grain sizes were obtained by using two different solution treatments" (see Table V). He goes on to say:- "Consequently, it is possible that there may be metallurgical dissimilarities other than grain size". S-N curves are given on Fig. 79.

Items 46-63 Refs. 39,42,40

The data on S-816 alloy come from three references. Item 46 is one of the materials mentioned in the discussion of Items 13-14, above. The S-N curves are shown on Fig. 70.

For item 47, an S-N curve is shown on Fig. 75, together with two other alloys for comparison. Note that each curve is based on a small number of specimens.

S-N curves for items 48-50 are given on Fig. 80. The values of S_e in Table V were scaled from Fig. 80.

The data for S_m and S_e for items 51-63 were derived from values scaled from S-N curves of "crest" stresses in the reference. Each curve was based on at least five specimens but in no case more than ten specimens.

Items 64-67 Ref. 4

The Sandvik steel was supplied to the investigator by Sandvikens Jernwerks Aktiebolag, Sandviken, Sweden. S-N curves for smooth and notched specimens and for two heat treatments are given on Fig. 81. Varying the heat treatment affected the fatigue strength of smooth specimens appreciably, but not the notched ones.

Items 68-70 Ref. 45

The material is 347 stainless steel. The S-N curves on Fig. 82, derived from curves in the reference, show the steady and the alternating components of the stress, on the stress scale. Note that the steady stress increases as the alternating stress increases.

Items 71-77 Refs. 45,39,42,40

The data on 403 stainless steel were collected from four references. For items 71-73, S-N curves on Fig. 83 show the steady and the alternating components of the stress.

For item 74, an S-N curve is shown on Fig. 70. This is one of the materials referred to in the discussion of items 13-14, above.

Item 75, 403 stainless steel, appears on Fig. 75 as one of three alloys shown on the figure for comparison. Note that each curve is based on a small number of specimens. Attention is called to the different values of S_e, at $2(10^7)$ cycles, in items 74 and 75. This primarily due to differences in heat treatment of this martensitic steel.

Items 76, 77 refer to fatigue strength at two different values of cycle life for 403 stainless steel heat treated much the same as the steel in item 75.

Items 78-80 Ref. 40

The "scatter diagrams" of the tests of Stellite 31 showed "relatively large scatter" which the reference says is "not unusual for cast materials and is probably due to the large primary grain size". The S-N curve, Fig. 84, show

an inversion of strength, for long-life notched specimens, that could perhaps be accounted for by the large scatter in a relatively small number of specimens. Values of S_e in Table V were scaled from Fig. 84.

Items 81-83 Ref. 40

Values of S_e for this 16-25-6 Timken Alloy were scaled from the S-N curves on Fig. 86.

Items 84-85 Ref. 39

These heat resistant materials TP-2B and TP-2-R (molybdenum with and without tungsten) are among those referred to in the discussion of items 13-14. Their S-N curves appear on Fig. 70.

Items 86-87 Ref. 36

Comments on items 5-6, above, apply to this Udimet-500. The S-N curves appear on Fig. 67.

Items 88-90 Ref. 40

S-N curves for this 6.3% Mo-Waspalloy are given on Fig. 85. Values of S_e in Table V were scaled from Fig. 85.

Items 91-102 Ref. 46

These are evaluation tests of General Electric's heat resistant nickel base alloy Rene 41, at room and at high temperatures. Two heats of this alloy were tested, but because of the small number of specimens available the variation between the heats could not be investigated completely. The values of S_e given in Table V were scaled from the S-N curves given in Figs. 87, 88, 89. Curves on Fig. 87 show fully reversed tests. Those on Figs. 88, 89, show steady loads combined with alternating loads.

The speed of testing is not given in the reference, therefore total elapsed time for 10^7 cycles cannot be stated. The "creep" effect presumably would be considerable at the high temperatures used, and would depend upon elapsed time. This suggests caution in using the values of S_e given.

SECTION IV. ALUMINUM ALLOYS

4.1 General

The titles of Tables VI to XI list the respective aluminum alloys according to the present Alcoa number code, but give also, in parentheses, the corresponding former code number. Within the tables, in the discussions, and on the figures, the code numbers used by the respective references appear.

4.2 Discussion of Data in Tables VI to XI

4.2.1 Aluminum Alloy 2014 (14S)

Items 1-2 Ref. 47

"Extruded" material - smooth - surface polished but smoothness not measured although "believed" to be about 20 micro-in. Fig. 90 shows tests on same material, under similar conditions excepting shape, machine, and speed. ("Sharp edges in the gage section were broken with emery paper".) Note that only nine specimens were tested for each S-N curve.

Items 3-6 Ref. 48

S-N curves for smooth and notched specimens are given on Fig. 91. The effect of steady stress on the 10^7 cycle strength of this 2014-T6 material is shown on Fig. 92.

Items 7-10 Ref. 49

The S-N curves, Fig. 93, show small differences between longitudinal and short transverse fatigue properties for this hand forged 2014-T6 alloy. (The forgings were 3" x 6" x 38" in size.) Similar curves are shown on Figs. 123 and 130 for other aluminum alloys.

4.2.2 Aluminum Alloy 2024 (24S)

Items 1-4 Ref. 50

These items show the effect of certain surface treatments on the alloy.

The anodizing process was as follows:

1. Clean with hot caustic soda bath.
2. Immerse in 15% H_2SO_4 both at 70°F.
3. Seal in water at 185°F.

For anodized and painted specimens, a fourth step:

4. Paint with zinc-chromate primer and normal finishing of Preparakote.

Microscopic examination of anodized surface showed that "entire surface was pitted".

The reference showed S-N curves from 10^4 to 10^7 cycles, for which 13 to 16 specimens were used for each curve.

The specimens used for items 3 and 4 were subjected to corrosion

during the fatigue stressing by "allowing plain tap water to drop slowly upon an extremely light-weight wick in contact with the specimen".

The author of reference 50 concludes that anodizing is detrimental. As a matter of fact, the anodized specimens (Item 2) appear to have about the same strength as specimens subjected to tap water corrosion (Item 3).

Item 5 Ref. 51

The curves, Figs. 94, 95 are for notched Alclad 24S-T3. They were traced from reference 51.

Items 6, 7 Ref. 52

Item 6 is Alclad and Item 7 is Bare 24S-T3. The type of testing machine used made it impossible to run a test at absolutely zero mean stress and constant amplitude. However, the variations were of about the same order as the scatter shown on the S-N curves, Fig. 96, which were traced from the reference report.

Items 8-9 Ref. 47

"Extruded" material - smooth - surface polished but smoothness not measured although "believed" to be about 20 micro-in. Fig. 97 shows tests on this material, under same conditions excepting shape, machine, and speed. ("Sharp edges in the gage section were broken with emery paper".) Only 6 or 8 specimens were tested for each S-N curve.

Items 10-13 Ref. 48

"Rolled" material - smooth and notched specimens of Alloy 24S-T4. Fig. 98 shows S-N curves for zero mean stress. The reference report gives also S-N curves for various constant ratios of alternating to mean stress. In this type of graph the mean (steady) stress is changing continuously throughout the graph. Therefore, these curves are not reproduced herein, but the equivalent information for 10^7 cycle life is given in Fig. 99.

Items 14-18 Refs. 9,10,53,54

Material, 24S-T3, commercial sheet, 0.090" thick. Each S-N curve depends upon from 5 to 12 or 15 tests. Authors believe that errors in load values do not exceed ±5%.

Fig. 100 shows S-N curves for fully reversed loading. Fig. 101 shows the effect of mean (steady) stress in reducing the alternating stress.

Items 19-21 Ref. 55

Material is 24S-T4 hot-rolled aluminum alloy. The authors, by slow bend tests on specimens fatigued part-way toward failure, determined that 24S-T4 has superior energy - absorption capacity, compared with 75S-T6, and lower notch-sensitivity. However, by re-heat treating 24S to approximately the hardness of 75S-T6, it was made to behave closely like 75S-T6.

Fig. 102 shows S-N curves for smooth and for notched 24S-T4, for fully reversed stresses.

Items 22-23 Ref. 56

Axial tests are reported in the reference at various "stress-ratios", i.e., combinations of steady and vibratory components of stress. Figs. 103 and 104 were plotted from Table 8 of the reference.

Item 24 Ref. 57

The material tested was thin 24S-T3 aluminum alloy. Tests were run at three significantly different rates in cpm, as shown on Fig. 105. It is probable that the S-N curve would actually be three different curves, if a complete set of tests had been made, at each of the three rates of cpm, for the range $N = 1$ to $N = 10^7$ cycles. No information is given as to the variability of the material. The reversal of stress from the tests at less than 50 cpm was not sinusoidal. Typical load-time curves, traced from the reference, are shown in Fig. 106.

4.2.3 Aluminum Alloy 6061 (61S)

Items 1-4 Ref. 58

The S-N curves on Figs. 107 and 108 show the effect of "zero to tension" stressing on the fatigue strength of the alloy. The curve for item 3, based on only three specimens, must be taken as less precise than the other curves. The stress scale for Fig. 108 shows the steady component separately from the alternating component.

Items 5-7 Ref. 45

Curves for these "zero to tension" tests on sheet 61S-T6 alloy, shown on Fig. 109, are based on larger numbers of specimens than those discussed above. However, they are not particularly different in the region 10^5 to 10^7 cycles.

4.2.4 Aluminum Alloy 7075 (75S)

Item 1 Ref. 51

The S-N curves shown on Figs. 110, 111, are for notched Alclad alloy 75S-T6. They were traced from ref. 51.

Items 2-13 Ref. 47

These items come from a study of the effect of type of specimen on fatigue properties of 75S-T6 aluminum alloy. It must be pointed out that the test results depend upon not only the type of specimen but also the type of testing machine and the speed of testing.

Fig. 112 shows results of tests, items 2 and 3, on extruded "75S-T". The surfaces were polished but the smoothness was not measured, although it was "believed" to be about 20 micrc-inches. "Sharp edges in the gage section were broken with emery paper". From 7 to 11 specimens were used for each S-N curve. For 75S-T6 plate material, S-N curves are given on Fig. 113. From 10 to 20 specimens were used for each of these curves.

Items 14-18 Refs. 9,10,53,54

The material is 75S-T6, commercial sheet, 0.090" thick. Each S-N curve depends upon from 5 to 12 or 15 tests. The authors believe that errors in load values do not exceed $\pm 5\%$.

Fig. 114 shows S-N curves for fully reversed loading. Fig. 115 shows the effect of mean (steady) stress in reducing the alternating stress. It should be noted that the curves on Fig. 115 are for the most part concave, which suggests that the straight-line "Goodman" diagram may not be conservative in all cases.

Items 19-21 Ref. 55

The material is 75S-T6 hot-rolled aluminum alloy. The authors, by slow bend tests on specimens fatigued part-way toward failure, determined that 75S-T6 has poorer energy-absorption capacity than 24S-T4, and higher notch-sensitivity. However, by reheat-treating 75S to approximately the hardness of 24S-T4, it was made to behave closely like 24S-T4. Fig. 116 shows S-N curves for smooth and for notched hot-rolled 75S-T6, for fully reversed stresses.

Items 22-24 Ref. 59

Fig. 117 shows S-N curves for smooth, and for notched, 75S-T6 Rolled and Drawn Rod. The plotted test points showed no apparent difference between longitudinal and transverse specimens. The crosses show anodic coatings, of thickness as follows: X = 0.00009" thick; + = 0.0005" thick. Authors conclude that the thin coat may be beneficial to smooth specimens, - and that notched specimens are not particularly sensitive to either thin or thick coatings.

Fig. 118 shows S-N curves for 75S-T6 Extruded Bar. Here, as in Fig. 117, the thin coat of anodizing material appears to slightly improve the fatigue strength of the alloy.

Item 25 Ref. 23

Fig. 119 shows the "mean" S-N curve and the "scatter band" for a total of 30 specimens. Caution: A "scatter band" is not a "probability" curve". Its width depends upon the variability of the material and the number of specimens tested. Increasing the number of specimens usually increases the width of scatter bands. For the material used in these tests the heat treatment was not given, but the static properties are about the same as others given in the data table for 75S-T6 aluminum alloy.

Item 26 Ref. 60

The material is 75S-T6. Fig. 120 shows the results of testing large numbers of specimens, plotted on logarithmic normal-probability paper. The lines are by no means straight, but by using a best-fit straight line for each stress level, S-N curves were plotted as shown in Fig. 121.

Item 27 Ref. 57

Material tested was 75S-T6 Aluminum Alloy. Tests were run at three significantly different rates in cpm, as shown on Fig. 122. It is probable that the S-N curve would actually be three different curves, if a complete set of tests had been made, at each rate of cpm, for the range $N = 1$ to $N = 10^7$ cycles. No information is given as to the variability of the material. The reversal of stress for the tests at less than 50 cpm was not sinusoidal. Typical load-time curves, traved from the reference, are shown in Fig. 106.

Items 28-31 Ref. 49

The S-N curves, Fig. 123, show considerable difference between longitudinal and short transverse smooth specimens of the hand forged alloy, but no significant difference for notched specimens. (The forgings were 3" x 6" x 38" in size.) Similar curves are shown on Figs. 93 and 130 for other aluminum alloys.

4.2.5 Aluminum Alloy 7076 (76S)

Items 1-9 Ref. 61

This material is 76S-T61, originally designated as M68, and referred to in reference 62 as X76S-T.

Fig. 124 shows S-N curves for bending, without and with superimposed steady bending stresses.

Fig. 125, similarly, shows S-N curves for torsion, without and with superimposed steady torsion stresses. Reference 61 also gives various tables and curves showing combinations of alternating bending and torsion with superimposed steady bending and torsion.

Items 10-21 Ref. 62

These tests were run in 1941 or 1942, on material that at that time was designated X76S-T.

It will be noticed that the composition and heat treatment are reported as identical with those reported in reference 61, for 76S-T61. There are not enough data regarding any one test to determine even approximately the variability of the material. Figs. 126 and 127 give S-N curves for this material, and Fig. 128 shows, for notched material, the relation of alternating to steady stress.

Items 22-23 Ref. 29

These tests were run to investigate the applicability of the Prot method of testing to aluminum alloys. The reference suggests the possibility that the much higher values of fatigue strength obtained by the Prot method may be due to some "coaxing" effect. Long-life S-N curves are given on Fig. 129.

4.2.6 Aluminum Alloy 7079

Items 1-4 Ref. 49

The S-N curves, Fig. 130, show some difference between longitudinal and short transverse smooth specimens of the hand forged alloy, but no significant difference for notched specimens. (The forgings were 3" x 6" x 38" in size.) Similar curves are shown on Figs. 93 and 123 for other aluminum alloys.

SECTION V. MAGNESIUM ALLOYS

5.1 General

Although there are numerous items in Table XII, a large number of them do not show the tensile (static) strength. Inspection of the Table will show that there seems to be little, if any, correlation of fatigue with static strength, so that the missing static strengths would be of only academic interest. A few data are given in Table XII (items 64 to 74) for high temperature fatigue.

5.2 Discussion of Data in Table XII

Items 1-12 Ref. 63

Regarding these tests on AZ31X, the reference says that the "HAE" process "produces electrolytically on magnesium alloys a nonmetallic coating that is hard and corrosion-resisting". The reference states that the coating reduced the fatigue strength by approximately 1000 psi for each 0.001 inch of coating. Several specimens were exposed to warm salt spray for five days then fatigue tested. The reference states that fatigue resistance was generally, but not invariably, not decreased by exposure to the spray. Fig. 131 gives S-N curves for item 1.

Items 13-29 Ref. 64

The material is Dow Chemical Co's. FS-1 alloy. Heat treatment is not specified in the reference, but the items marked FS-1a are presumably annealed and those marked FS-1h are presumably hard rolled. Most of the data were from sheets, and to avoid buckling from compression the stress ranges for these tests were kept between zero and a maximum tension.

Warning: The reference says: ". . . it is recommended that the test bar data presented here not be used quantitatively for design values, but rather, simply for a qualitative comparison of materials".

Items 30-43 Ref. 64

The warning above applies also to the data on the magnesium casting alloys, C-AC, C-HT, C-HTA, and C-HTS.

Items 44-48 Ref. 65

Material is Dow FS-1h. Fatigue strengths were measured in terms of R (ratio min. to max. stress per cycle).

Fig. 132 shows the S-N-R curves, i.e., the curves for crest stresses. Fig. 133 was derived by converting values scaled from Fig. 132 into equivalent separate steady and vibratory components for 10^7 cycles.

Items 49-51 Ref. 66

Material is magnesium alloy ZK60A-T5 (Dow Chem.), Extruded bar stock. This is a "solid solution precipitation hardening type with Mg-Zn compound as the submicroscopic precipitate".

Fig. 134 shows S-N curves, for fully reversed stress, of smooth and of notched specimens.

Figs. 135 and 136 show, in modified Goodman type diagrams, the influence of steady stress on alternating stress strength.

Items 52-53 Ref. 4

Approximate S-N curves for magnesium alloy J-1 are given in Fig. 137.

Items 54-61 Ref. 67

These tests on three magnesium alloys, FS-1a, J-1, and O-1, were made to show the difference in fatigue strength of the alloys caused by differences in the test methods. The individual specimen tests are plotted in Figs. 138-140. As a result of these tests the authors of the reference state that some magnesium alloys give appreciably higher strengths in rotating bending than in plate bending or in axial (push-pull) loading.

No S-N curves were given in the reference, but values of "Fatigue Limit, 10^7 cycles" were given. These are the values used in Table XII.

Items 62-63 Ref. 68

The tests on AZ81-T4 cast alloy were made "to compare the fatigue properties of AZ81-T4 with other similar magnesium alloys now in service". The reference concludes that "the unnotched fatigue strength of AZ81-T4 is approximately 4 ksi lower than AZ63-T4" and "the notched fatigue properties were practically identical to those of AZ63-T4". S-N curves are given on Fig. 141.

Items 64-69 Ref. 69

The tests on HM-31 forged alloy are plotted on Fig. 142 together with "results of previous testing on annealed HK-31 magnesium alloy". The values shown on the figure are based on stressing from zero to tension (A = 1.0). In addition to the tests plotted, "a limited number of the specimens were also tested in completely reversed loading", with the following results:

At room temp., stress 15 ksi, one specimen failed at 2,085,500 cycles and one specimens failed at 3,875,000 cycles.

At 500°F, stress 12 ksi, one specimen failed at 91,700 cycles.
stress 9 ksi, one specimen failed at 1,102,300 cycles.

At 650°F, stress 7 ksi, one specimen failed at 1,100,900 cycles after having survived 10^8 cycles at 10 ksi at 500°F.

Items 70-74 Ref. 70

These tests of HM-21 forged alloy were "preliminary", - for comparison with HM-31 alloy. S-N curves are shown on Fig. 143.

6.1 General

It is interesting to note that in Table XIII the fatigue strengths of smooth titanium alloys run close to, and sometimes exceed, fifty percent of the tensile strengths. A few data (items 67 to 86) are given on high temperature properties.

6.2 Discussion of Data in Table XIII

Items 1-6 Ref. 71

Alloy RC-55 Type. Reduction in endurance limit of smooth specimens, item 5, is charged to the heating effect resulting from high speed cycling, when cpm are increased from 1,800 to 10,000. The fact that notched specimens, item 6, showed little effect from speed, and did not heat up, is thought to be because of the relatively small volume of material subjected to maximum stress and the ability of surrounding material to conduct the heat away as fast as generated.

Fig. 144 shows the S-N curves for this alloy. It is to be noticed that the curves are based on small numbers of specimens. The total number of specimens for each curve is noted on the figure.

Items 7-14 Ref. 72

The reference refers to earlier tests on Rem-Cru sheet 0.060" thick, tested in Krouse sheet fatigue machines, and remarks: "The fatigue values were higher in the transverse direction than in the longitudinal direction for all conditions. No completely satisfactory reasons could be given to account for the annealed and pickled samples producing the best results and the cold rolled specimens the poorest results". The tests reported in reference 72 were made to study further some of the problems referred to above.

The variability of Ti-alloys appears in an analysis of the static properties as reported in reference 72:- (Standard deviations have been computed from the data in the report.

Alloy	UTS ksi	ST. DEV.	YP ksi	St. DEV.
Ti-150A *	143.0	5.9	127.6	6.0
RC-130B	153.6	3.2	147.1	5.2

* Reference 72 says: "These melts were early experimental ones and consequently were not of comparable quality to melts produced at present".

The following excerpt is quoted from subject report:

ABSTRACT

"The evaluation of the effects of various treatments on the fatigue properties of titanium bar stock alloys Ti-150A and RC-130B was made. The various treatments of Ti-150A and their corresponding fatigue endurance limits are as follows:

1. Machined and polished - 68,000 psi
2. Ground - 63,000 to 70,000 psi
3. Ten percent permanently stretched and ground - 54,000

psi (wide scatter of data)
4. Ground and scaled - 56,000 psi
5. Machined notched - 40,000 psi
6. Ground and notched - 21,000 psi

The fatigue strength varied from about 35 to 45 percent of the tensile ultimate strength for the different treatments, except for the notched condition as would be expected. RC-130B gave endurance limits of about 67,000 psi (approximately 45 percent of tensile ultimate strength) for the ground, unnotched condition, and about 24,000 psi for the ground notched material. The wide range of values for the ground Ti-150B alloy and for the 10 percent stretched and ground Ti-150A alloy may have been due to various degrees of surface cold work, and surface discontinuities, caused by grinding and cold work. In addition, radiography identified tungsten inclusions which were probably a contributing factor. In general the surface treatment has a marked effect upon the fatigue strength of titanium and its alloys. For the conditions tested, a machined and polished surface produced the optimum fatigue properties."

Fig. 145 shows the evidence upon which the discussion of items 7 to 14 is based. The high degree of scatter must be considered in connection with the values stated for "fatigue endurance limits".

Item 15 Ref. 73

These tests of RC-130B titanium alloy were run to provide data for a study of the statistical nature of the material. In the reference report the data are analyzed by using the means of the reciprocals of the life cycles. In Fig. 146, the P-S-N (Probability-S-N) curves were established by probit analysis (reference 29).

Items 16-40 Refs. 74,75

The values of S_e for 10^7 cycles that appear in the data tables were scaled from curves in the references. These values are listed as "plus-or-minus" values to indicate that they are not highly precise in the second significant figure. In general only three or four - sometimes five - specimens were tested at any one stress level.

Items 41-44 Ref. 76

These items show the sensitivity of the nearly pure titanium, Ti-75A, to heating under high speed cycling, and to extremes of speed, that is, from 400 RPM to 10,000 RPM. The reference says, however, that "specimens which were water cooled to dissipate the internal heat showed small spread in the failure curves for the different speeds of testing that were studied". Fig. 147 shows S-N curves for these items. Values of S_e in Table XIII were scaled from Fig. 147.

Items 45-62 Ref. 77

In these tests of titanium-chromium-molybdenum alloys, 20 specimens were used in tests for each value of S_e. For the data in Table XIII, static properties excepting UTS were scaled from graphs in the reference. In their Summary, the authors refer to Fig. 148 and say:- "The fatigue endurance limit of the alloy appears to be unchanged, regardless of alloy content, although the tensile strength is greatly increased as a result of alloy content".

Items 63-64 Ref. 78

The two S-N curves for 6 Al-4 Va titanium alloys shown on Fig. 149 represent tests run to "illustrate the improvement in endurance strength which can be realized using duplex heat treatments".

Item 65 Ref. 29

The S-N curve for 6 Al-4 Va titanium alloy shown on Fig. 150 is based on tests of 63 specimens, whereas the lower curve of the same material shown on Fig. 149 is based on 8 specimens, only four of which broke at less than 10^8 cycles. Whether or not this alloy has an "endurance limit" at around 10^7 or 10^8 cycles is questionable.

Item 66 Ref. 38

The reference says of the S-N curves for 6 Al-4 V titanium alloy bar from which Fig. 151 was derived that they show "some limited axial . . . fatigue data". The scale of stresses on Fig. 151 should be read carefully. They indicate the steady stress component as well as the vibratory component of stress, and it should be noted that the steady stress increases as the alternating stress increases.

Items 67-86 Ref. 79

These tests of 7 Al-3 Mo titanium alloy were made to study the effect of ageing versus annealing treatments on the high temperature creep and fatigue properties of the alloy. The S-N curves, Figs. 152 and 153, were derived from curves given in the reference. The stress scales on the figures show the steady stress component and the alternating stress component.

SECTION VII. MISCELLANEOUS MATERIALS

7.1 General

The data in Table XIV apply to plastic and wood laminates and a few metallic materials. Some data on high temperature properties of beryllium are included.

7.2 Discussion of Data in Table XIV

Items 1-2 Ref. 8

The Ingot Iron used for item 2 was specially treated "to retain as much carbon and nitrogen in solid solution as possible". This treatment was used to render the iron more susceptible to "coaxing" under fatigue stressing, so that the effect of coaxing on Prot tests could be investigated.

Items 3-4 Ref. 4

In the case of this gray (cast) iron, the plots of individual test results as given in the reference warrant the drawing on Fig. 154 of a single S-N curve to represent both the smooth and the notched specimens.

Items 5-6 Ref. 29

For the aluminum-nickel bronze, Item 5, 76 specimens were tested to give the S-N curves shown on Fig. 155. For the beryllium-copper, Item 6, 66 specimens were tested for the S-N curves on Fig. 156. The values of S_e given in Table XIV are probably higher than would be shown for longer cycle life.

Items 7-17 Ref. 80

S-N curves for these glass-fiber-reinforced plastic laminates are given on Figs. 157, 158. The strength reduction factor of these notched laminates is noticeably smaller than that usually found in metals, and in the case of the laminate with a glass mat, items 14-15, is actually less than unity.

Items 18-23 Ref. 80

These items, showing the effect of superimposed mean (steady) stress, are shown as S-N curves on Fig. 159, for a single laminate.

Item 24 Ref. 80

This item, represented by the S-N curve on Fig. 160, shows the effect of stressing the glass-fabric-reinforced laminate at 45° with the direction of the warp. The effect of anisotropy can be seen by comparing this item with item 18.

Items 25-30 Ref. 80

S-N curves for these heat resistant glass-fiber-reinforced laminates are given on Figs. 161,162.

Item 31 Ref. 42

An S-N curve for this glass fabric laminated plastic is given on Fig. 163. The curve is considerably different in character from most of those

on Figs. 157 to 162 although the long life fatigue strength is consistent with those of the other laminates. The specimens were round instead of flat, the stressing was in bending instead of being axial, and the resin was not identical with those used for the other laminates. The reference says:- "The decrease in fatigue strength value with increasing number of cycles is relatively small".

Items 32-47 Ref. 81

Values of S_e for these tests of yellow birch and hard maple, both solid and laminated, were scaled from Fig. 164 for 10^8 cycles. It must be remembered that these values are "mean" strengths of laboratory-size specimens. The "scatter" in data cannot be determined since each S-N curve was based on somewhere between half a dozen and a dozen and a half specimens. The reference points out that the "endurance limit" for these woods is apparently below the 10^8 cycle strength, and there is no indication in the tests of how far below.

A variable not listed in the tabulation is "moisture content". The reference gives 7 or 8% by weight for the natural woods, and 1.6 to 3.5% for the compressed laminates. The reference says "it is believed that no serious change in moisture content occurred during the test".

One respect in which the data in the last eight items differs from values for steel is in the effect of increased speed of cycling. There is a small but persistent decrease in fatigue strength as speed increases from 3450 to 10,600 cpm. Steels have not been found so sensitive at these speeds, and for much wider differences have shown the opposite effect.

Items 48-49 Ref. 82

Data for these flat-plate bending tests of solid and laminated wood specimens are given as percents of the static modulus of rupture "because specimens of the same species from different trees will vary considerably in strength". Test results are shown on Fig. 165 as a "scatter band" since the separate test values for the two solid and the two laminated woods were completely intermingled on the figure in the reference. This is consistent with the statement in the reference:- "Since the shear stress is relatively low compared to the fiber stress in bending, it has been found that plywood specimens tested as cantilever beams subjected to repeated or reversed bending stress, with the plane of the veneers perpendicular to the load and the grain of the outside plies parallel to the span, will fail in the wood before separation of the veneers occurs".

The average value, 27% of static modulus of rupture, is given for 50,000,000 cycles, and the reference points out that the slope of the S-N curves is still negative, indicating that this is not the "endurance limit" of the woods tested.

Item 50 Ref. 83

The S-N curve, as based on four specimens, is shown on Fig. 166.

Regarding other data on beryllium, the reference states that other investigators have reported "the fatigue strength under direct stress of hot pressed, warm extruded Beryllium to be 31,300 psi at 10^8 cycles", and the "fatigue strength of Beryllium under cantilever bending . . . as 32,000 psi". Also, it quotes another set of tests as showing that strip specimens under direct stress showed "an endurance limit at 10^7 cycles of 22,000 psi".

Item 51 Ref. 84

The 1100°F stress-rupture data for Brush QMV Beryllium are plotted on Fig. 167.

Items 52-63 Ref. 85

The axial test data for Brush QMV Beryllium given by the reference are plotted on Figs. 168-170. Fig. 168 shows room temperature tests and Figs. 169, 170 show tests at 1100°F. Each of the S-N curves shown is based on a small number of specimens. The data in Table XIV were read from the S-N Curves.

Table I. SAE Steels 1008 to 4335

Item	Ref.	Description		Fatigue Properties K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Testing Machine Type	Kind of Test	Speed cpm	Specimen Size	Surface Finish
1	3	SAE 1008 Steel.	Grain Size ASTM 7-9.	1.0	No	28±	---	10^7	Sonntag	Push-Pull	1800	0.200" ∅	4/0 and Electro-Polish
2	"	SAE 1008 Steel. Decarburized	Grain Size ASTM 3-5.	"	"	18±	---	"	"	"	"	"	"
3	"	"	"	"	"	17±	---	"	R.R. Moore	Rot. Bend.	9000	0.220" ∅	Ground, Electro-Polish
4	4	1020 Steel.	Smooth	1.0	No	35.5	---	$2(10^7)$	------	Rot. Cantil.	1500±	0.6"± ∅	900 Grit
5	"	"	60° V-notch R = 0.010"	3.9	"	13.0	---	"	------	"	"	0.584" ∅	------
6	5	Hot-Rolled 1040 Steel.	Smooth	1.0	No	39.3	---	10^7	R.R. Moore	Rot. Bend.	10,000	0.220" ∅	Lapped
7	"	"	60° V-notch R = 0.015"	2.2	"	25.8	---	"	"	"	"	"	"
8	"	"	Smooth	1.0	"	43.5	---	"	"	"	"	"	"
9	"	"	60° V-notch R = 0.015"	2.2	"	27.2	---	"	"	"	"	"	"
10	"	Cast 1040 Steel.	Smooth	1.0	"	33.2	---	"	"	"	"	"	"
11	"	"	60° V-notch R = 0.015"	2.2	"	26.0	---	"	"	"	"	"	"
12	"	"	Smooth	1.0	"	37.7	---	"	"	"	"	"	"
13	"	"	60° V-notch R = 0.015"	2.2	"	28	---	"	"	"	"	"	"

Table I. SAE Steels 1008 to 4335 (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
1	58.4	38.7	36 1"	71.9	RB 62-64	C-0.09, Si-0.14, Mn-0.46, P-0.010, S-0.027, Cr-0.08, Ti-0.01, Mo-0.01, Ni-0.07, Cu-0.05	Received as hot-rolled rod. No special heat treatment.
2	40.9	12.1	47.5 1"	85	RE 67-70	C-0.003/0.005, Si-0.14, Mn-0.46, P-0.010, S-0.027, Cr-0.08, Ti-0.01, Mo-0.01, Ni-0.07, Cu-0.05	Decarburized in water saturated hydrogen at 140°F:- 100 hr. at 1725°F, followed by 100 hrs. at 1290°F.
3	"	"	"	"	"	"	"
4	71.3	46.6 0.2%	25 2"	60.5	---	C-0.15/0.25, Mn-0.3/0.6, S-0.055, P-0.45	-----
5	"	"	"	"	---	"	-----
6	81.4	47.6 0.2%	31 2"	54.6	Bhn 149	C-0.39, Mn-0.82, Si-0.28, P-0.020, S-0.037	Annealed 1650°F.
7	"	"	"	"	"	"	"
8	90	55.7	26.5	58.3	170	"	Normalized 1650°F, Tempered 1200°F.
9	"	"	"	"	"	"	"
10	83.5	49.3	27.5	46.7	156	C-0.39, Mn-0.78, Si-0.47, P-0.023, S-0.039	"
11	"	"	"	"	"	"	"
12	94.2	56	24.5	52.2	187	"	"
13	"	"	"	"	"	"	"

Table I. SAE Steels 1008 to 4335 (Continued)

Item	Ref.	Description		Fatigue Properties K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Testing Machine Type	Kind of Test	Speed cpm	Specimen Size	Surface Finish
14	5	Cast 1330 Steel.	Smooth	1.0	No	48.4	---	10^7	R.R. Moore	Rot. Bend.	10,000	0.220" ϕ	Lapped
15	"	"	60° V-notch R = 0.015"	2.2	"	31.7	---	"	"	"	"	"	"
16	"	"	Smooth	1.0	"	41.7	---	"	"	"	"	"	"
17	"	"	60° V-notch R = 0.015"	2.2	"	31.2	---	"	"	"	"	"	"
18	"	"	Smooth	1.0	"	58.5	---	"	"	"	"	"	"
19	"	"	60° V-notch R = 0.015"	2.2	"	37.3	---	"	"	"	"	"	"
20	"	Hot-Rolled 1340 Steel.	Smooth	1.0	No	58.7	---	10^7	R.R. Moore	Rot. Bend.	10,000	0.220" ϕ	Lapped
21	"	"	60° V-notch R = 0.015"	2.2	"	33.0	---	"	"	"	"	"	"
22	"	"	Smooth	1.0	"	68.4	---	"	"	"	"	"	"
23	"	"	60° V-notch R = 0.015"	2.2	"	36.3	---	"	"	"	"	"	"
24	6	2315 Carburized Steel Core Bhn 363. Carb. depth 0.040"-0.044". Grain Size ASTM 2-5.		1.0	No	108	---	10^7	R.R. Moore	Rot. Bend.	----	0.250" ϕ	Polish
25	"	2315 Carburized Steel Core Bhn 341. Carb. depth 0.040"-0.044". Grain Size ASTM 2-5		"	"	105	---	"	"	"	----	"	"
26	"	2315 Carburized Steel. Core Bhn 187. Carb. depth 0.040"-0.044". Grain Size ASTM 2-5.		"	"	101	---	"	"	"	----	"	"

Table I. SAE Steels 1008 to 4335 (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
14	99.3	61.5	24.0	58.5	Bhn 201	C-0.31, Mn-1.64, Si-0.47, P-0.015, S-0.022	Normalized 1650°F, Tempered 1200°F.
15	"	"	"	"	"	"	"
16	97.0	63.5	26.0	58.5	201	C-0.30, Mn-1.50, Si-0.42, P-0.031, S-0.043	Normalized 1650°F, Tempered 800°F.
17	"	"	"	"	"	"	"
18	122.2	106.0	20.5	55.6	269	C-0.31, Mn-1.64, Si-0.47, P-0.015, S-0.022	Quenched 1550°F, Tempered 1150°F.
19	"	"	"	"	"	"	"
20	101.8	56.8	23.5	60.1	Bhn 207	C-0.38, Mn-1.68, Si-0.35, P-0.020, S-0.025	Normalized 1650°F, Tempered 1200°F.
21	"	"	"	"	"	"	"
22	121.2	106.9	22.5	60.9	269	"	Quenched 1525°F, Tempered 1200°F.
23	"	"	"	"	"	"	"
24	288	142	---	---	Rc 59-61	C-0.15, Mn-0.54, P-0.025, S-0.021, Ni-3.68	Carb. 1650°F, 6 hrs., OQ; Temp. 300°F.
25	293	149	---	---	60-62	"	Carb. 1650°F, 6 hrs., OQ; 1375°F after carb.
26	187	130	---	---	59-61	"	Carb. 1650°F, 6 hrs., OQ; 1330°F after carb.

Table I. SAE Steels 1008 to 4335 (Continued)

Item	Ref.	Description	Fatigue Properties					Testing Machine			Specimen	
			K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Type	Kind of Test	Speed cpm	Size	Surface Finish
27	6	2315 Carburized Steel Core Bhn 197. Carb. depth 0.032. Grain Size ASTM 2-5	1.0	No	98.5	---	10^7	R.R. Moore	Rot. Bend.	----	0.250" ø	Polish
28	"	2315 Carburized Steel Core Bhn 341. Grain Size ASTM 2-5	"	"	120	---	"	"	"	----	"	"
29	"	2315 Carburized Steel Core Bhn 341. Grain Size ASTM 2-5	"	"	115	---	"	"	"	----	"	"
30	"	2315 Carburized Steel	"	"	120±	---	"	"	"	----	"	"
31	"	2315 Carburized Steel Core Bhn 363. Grain Size ASTM 2-5. Notched	3.1 to 3.5	"	42±	---	"	"	"	----	See Fig. 9	-----
32	"	2315 Carburized Steel Core Bhn 341. Grain Size ASTM 2-5. Notched	"	"	39±	---	"	"	"	----	"	-----
33	"	2315 Carburized Steel Core Bhn 187. Grain Size ASTM 2-5. Notched	"	"	39±	---	"	"	"	----	"	-----
34	"	2330 Carburized Steel Core Bhn 514. Carb. depth 0.031". Grain Size ASTM 5-7	1.0	No	133	---	10^7	R.R. Moore	Rot. Bend.	----	0.250" ø	Polished
35	"	2330 Carburized Steel Core Bhn 395. Carb. depth 0.041". Grain Size ASTM 5-7	"	"	157	---	"	"	"	----	"	"
36	"	2330 Carburized Steel Core Bhn 514. Carb. depth 0.030". Grain size ASTM 5-7	"	"	147	---	"	"	"	----	"	"
37	"	2330 Carburized Steel Core Bhn 321. Grain Size ASTM 5-7. Notched	3.1 to 3.5	"	44±	---	"	"	"	----	See Fig. 9	-----

Table I. SAE Steels 1008 to 4335 (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
27	198	130	---	---	60-61	C-0.15, Mn-0.54, P-0.025, S-0.021, Ni-3.68	Carb. 1650°F, 6 hrs., OQ.
28	295	187	---	---	60-61	"	Carb. 1650°F, 6 hrs., OQ; 1475°F, OQ; Temp. 300°F.
29	296	187	---	---	60-61	"	Carb. 1650°F, 6 hrs., OQ; Furnace 1475°F, OQ.
30	---	---	---	---	---	"	Carb. 1650°F, 6 hrs., OQ; Surface Polish, Reheat in Cyanide, 1475°F, OQ, Temp. 300°F.
31	288	142	---	---	59-61	C-0.18, Mn-0.48, P-0.025, S-0.017, Ni-3.58	Carb. 1650°F, 8 hrs., OQ; Temp. 300°F.
32	293	149	---	---	60-62	"	Carb. 1650°F, 8 hrs., OQ; Furnace 1375°F, OQ; Temp. 300°F.
33	187	130	---	---	59-61	"	Carb. 1650°F, 8 hrs., OQ; Reheat 1330°F, OQ; Temp. 300°F.
34	266	173	---	---	Rc 61	C-0.31, Mn-0.70, P-0.025, S-0.023, Ni-3.31	Carb. 1650°F, 3 hrs. to furnace 1375°F, OQ; Temp. 300°F.
35	322	264	---	---	60	"	Carb. 1650°F, 6 hrs., OQ; 1375°F, OQ; Temp. 300°F.
36	326	240	---	---	63	"	Carb. 1650°F, 3 hrs., OQ; 1375°F, OQ; Temp. 300°F.
37	206	142	---	---	63	"	Carb. 1650°F, OQ; Reheat1375°F, OQ; Temp. 300°F.

Table I. SAE Steels 1008 to 4335 (Continued)

Item	Ref.	Description		Fatigue Properties					Testing Machine			Specimen	
				K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Type	Kind of Test	Speed cpm	Size	Surface Finish
38	8	2340 Steel.	Smooth	1.0	No	69	---	10^7	R.R. Moore	Rot. Bend.	3600	0.25" ϕ	Polished
39	"	"	Semi-circ. notch. R = 0.050"	Yes	"	38	---	"	"	"	"	"	-----
40	9	SAE 4130 Steel.	Smooth	1.0	No	47	---	10^7	Krouse	Axial	1100-1500	0.075" Thick	-----
41	10	"	Notched	1.5	"	36	---	"	"	"	"	"	-----
42	"	"	"	2.0	"	27	---	"	"	"	"	"	-----
43	"	"	"	4.0	"	14	---	"	"	"	"	"	-----
44	"	"	"	5.0	"	10	---	"	"	"	"	"	-----
45	5	Cast 4135 Steel.	Smooth	1.0	"	51.2	---	10^7	R.R. Moore	Rot. Bend.	10,000	0.220" ϕ	Lapped
46	"	"	60° V-notch R = 0.015"	2.2	"	33.3	---	"	"	"	"	"	"
47	"	"	Smooth	1.0	"	61.3	---	"	"	"	"	"	"
48	"	"	60° V-notch R = 0.015"	2.2	"	40.6	---	"	"	"	"	"	"
49	"	Hot-Rolled 4140 Steel.	Smooth	1.0	"	62.0	---	"	"	"	"	"	"
50	"	"	60° V-notch R = 0.015"	2.2	"	31.2	---	"	"	"	"	"	"
51	"	"	Smooth	1.0	"	87.4	---	"	"	"	"	"	"
52	"	"	60° V-notch R = 0.015"	2.2	"	41.2	---	"	"	"	"	"	"

Table I. SAE Steels 1008 to 4335 (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
38	112.9	92.1	26.5 2"	64.8	RB 99	C-0.40, Mn-0.74, P-0.019, S-0.20, Si-0.28, Ni-3.48	1450°F, 30 min., OQ; Temper 1200°F, 1 hr.
39	"	"	"	"	"	"	"
40	117	98.5	14.2	---	---	-----	Normalized.
41	117	"	"	---	---	-----	"
42	"	"	"	---	---	-----	"
43	"	"	"	---	---	-----	"
44	"	"	"	---	---	-----	"
45	112.7	86.5	18.0	43.1	223	C-0.37, Mn-0.82, Si-0.45, P-0.035, S-0.027, Cr-0.88, Mo-0.19	Normalized 1650°F, Tempered 1200°F.
46	"	"	"	"	"	"	"
47	146.4	131.0	14.0	35.8	311	"	Quenched 1550°F, Tempered 1175°F.
48	"	"	"	"	"	"	"
49	111.1	86.1	23.4	62.9	223	C-0.39, Mn-0.84, Si-0.28, P-0.019, S-0.029, Cr-0.96, Mo-0.19	Normalized 1650°F, Tempered 1200°F.
50	"	"	"	"	"	"	"
51	146.8	133.0	18.5	60.1	311	"	Quenched 1525°F, Tempered 1150°F.
52	"	"	"	"	"	"	"

Table I. SAE Steels 1008 to 4335 (Continued)

Item	Ref.	Description	Fatigue Properties K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Testing Machine Type	Kind of Test	Speed cpm	Specimen Size	Surface Finish
53	11	4320 Steel. Specimens Transverse to rolling.	1.0	No	71	---	10^7	Krouse	Reversed Cant.Bend.	1725	3/16" x 12"	-----
54	12	4320 Steel. This test Not Nitrided. 60° V-notch, 0.002" R.	4.8	No	21	---	10^7	R.R. Moore	Rot. Bend.	----	0.230" ϕ	-----
55	"	4320 Steel. Nitrided 975°F, 8 hrs., 0.004-0.005" depth. 60° V-notch, 0.002" R.	"	"	65	---	"	"	"	----	"	-----
56	"	4320 Steel. Nitrided 975°F, 15 hrs., 0.008" depth. 60° V-notch, 0.002" R.	"	"	75	---	"	"	"	----	"	-----
57	"	4320 Steel. This test Not Nitrided. 60° V-notch, 0.010" R.	2.6	"	26	---	"	"	"	----	"	-----
58	"	4320 Steel. Nitrided 975°F, 8 hrs., 0.004-0.005" depth. 60° V-notch, 0.010" R.	"	"	68	---	"	"	"	----	"	-----
59	"	4320 Steel. Nitrided 975°F, 15 hrs., 0.008" depth. 60° V-notch, 0.010" R.	"	"	78	---	"	"	"	----	"	-----
60	13	V-modified 4330 Steel Smooth	1.0	No	83±	---	10^7	-----	Rot. Bend.	----	0.188" ϕ	Mech. Polish
61	"	" 60° V-notch, 0.038" Deep, R = 0.0007"	8.0	"	65±	---	"	-----	"	----	"	-----
62	"	" Smooth	1.0	"	91±	---	"	-----	"	----	"	Mech. Polish
63	"	" 60° V-notch, 0.038" Deep, R = 0.0007"	8.0	"	55±	---	"	-----	"	----	"	-----

Table I. SAE Steels 1008 to 4335 (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
53	141	130 0.2%	15	---	Dph 310-346	C-0.22, Mn-0.85, Si-0.30, S-0.015, P-0.018, Cr-1.09, Ni-2.10, Mo-0.33	-----
54	(UTS not given. Believed to be about 140 ksi.)				---	C-0.17, Mn-0.84, Si-0.41, S-0.018, P-0.012, Cr-0.97, Ni-2.04, Mo-0.43	Norm. 1600°F, 45 min., 30 sec. delay, OQ; 1600°F, 45 min.; Temp. 1060°F, 1.5 hrs.; Stress Relieve 1060°, 1 hr.
55	"	"	"	"	---	"	"
56	"	"	"	"	---	"	"
57	"	"	"	"	---	"	"
58	"	"	"	"	---	"	"
59	"	"	"	"	---	"	"
60	263	177±	17±	49±	---	C-0.32, Mn-0.88, P-0.012, S-0.018, Si-0.26, Ni-1.79, Cr-0.84, Mo-0.355, V-0.07	1660°F, OQ; Tempered 270°F.
61	"	"	"	"	---	"	"
62	250	197±	17±	52±	---	"	1660°F, OQ; Tempered 400°F.
63	"	"	"	"	---	"	"

Table I. SAE Steels 1008 to 4335 (Continued)

Item	Ref.	Description		Fatigue Properties					Testing Machine			Specimen	
				K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Type	Kind of Test	Speed cpm	Size	Surface Finish
64	13	V-modified 4330 Steel.	Smooth	1.0	No	93±	---	10^7	-----	Rot. Bend.	-----	0.188" ϕ	Mech. Polish
65	"	"	Smooth	1.0	"	91±	---	"	-----	"	-----	"	"
66	"	"	Smooth	1.0	"	84±	---	"	-----	"	-----	"	"
67	"	"	60° V-notch, 0.038" Deep, R = 0.0007"	8.0	"	6.5±	---	"	-----	"	-----	"	-----
68	14	4330 Steel.	Longitudinal	1.0	No	88.4	4.4	Prot	Krouse	Rot. Cantil.	8,000	0.223" ϕ	4 micro-in.
69	"	"	Transverse Same heat as Item 68.	"	"	83.2	2.6	"	"	"	"	"	"
70	"	"	Longitudinal	"	"	88.4	9.4	"	"	"	"	"	"
71	"	"	Transverse Same heat as Item 70.	"	"	82.4	9.3	"	"	"	"	"	"
72	"	"	Longitudinal	"	"	94.1	3.5	"	"	"	"	"	"
73	"	"	Transverse Same heat as Item 72.	"	"	91.6	5.9	"	"	"	"	"	"
74	5	Cast 4335 Steel.	Smooth	1.0	No	63.0	---	10^7	R.R. Moore	Rot. Bend.	10,000	0.220" ϕ	Lapped
75	"	"	60° V-notch R = 0.015"	2.2	"	34.9	---	"	"	"	"	"	"
76	"	"	Smooth	1.0	"	77.6	---	"	"	"	"	"	"
77	"	"	60° V-notch R = 0.015"	2.2	"	48.2	---	"	"	"	"	"	"

Table I. SAE Steels 1008 to 4335 (Continued)

Item	UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
	Static Properties						
64	236	195±	16±	55±	---	C-0.32, Mn-0.88, P-0.012, S-0.018, Si-0.26, Ni-1.79, Cr-0.84, Mo-0.355, V-0.07	1660°F, OQ; Tempered 500°F.
65	222	190±	16±	57±	---	"	1600°F, OQ; Tempered 650°F.
66	201	185±	16±	55±	---	"	1600°F, OQ; Tempered 800°F.
67	"	"	"	"	---	"	1600°F, OQ; Tempered 800°F.
68	205 Long.	194 Long.	11.0 Long.	46 Long.	Rc 43 Long.	C-0.33, Mn-0.69, P-0.015, S-0.023, Si-0.029, Ni-1.72, Cr-0.80, Mo-0.32, V-0.18	Salt bath 1550°F, 15 min., OQ; Tempered 30 min. to RC 41±2 on 13/32" ϕ
69	197 Trans.	180 Trans.	8.0 Trans.	32 Trans.	42 Trans.	"	"
70	199 Long.	193 Long.	10.5 Long.	46 Long.	42 Long.	C-0.34, Mn-0.67, P-0.014, S-0.013, Si-0.26, Ni-1.80, Cr-0.90, Mo-0.33, V-0.18	"
71	209 Trans.	199 Trans.	9.5 Trans.	39 Trans.	43 Trans.	"	"
72	214 Long.	210 Long.	12.7 Long.	52 Long.	43 Long.	C-0.31, Mn-0.68, P-0.013, S-0.017, Si-0.29, Ni-1.80, Cr-0.84, Mo-0.32, V-0.18	"
73	214 Trans.	206 Trans.	9.0 Trans.	38 Trans.	43 Trans.	"	"
74	126.5	100.5	14.5	50.3	262	C-0.34, Mn-0.60, Si-0.49, P-0.034, S-0.036, Cr-0.70, Ni-1.74, Mo-0.30	Normalized 1650°F, Tempered 1125°F.
75	"	"	"	"	"	"	"
76	168.2	155.9	9.5	17.8	Bhn 375	C-0.34, Mn-0.60, Si-0.49, P-0.034, S-0.036, Cr-0.70, Ni-1.74, Mo-0.30.	Quenched 1525°F, Tempered 1025°F.
77	"	"	"	"	"	"	"

Table II. SAE Steels 4340 and 4350

Item	Ref.	Description	Fatigue Properties K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Testing Machine Type	Kind of Test	Speed cpm	Specimen Size	Surface Finish
1	15,16	4340 Steel. Tests stopped at "incipient fracture". Microstructure, ferrite & tempered martensite.	1.0	No	89.7	7.1	$25(10^7)$	GE Vib. Cantil.	Bending	7,650 ±	0.500"x 0.300"	-----
2	"	4340 Steel. As above, except micro-structure was ferrite & fine spheroidite.	"	"	57.4	2.5	"	"	"	"	"	-----
3	17	4340 Steel. Failure - visible crack.	1.0	No	82.5	---	$3(10^7)$	Rot. Cant.	Rev. Bend. Const. Force	2,100	1/8" ø	2/0
4	"	" "	"	"	81.0	---	"	"	"	3,600	1/4" ø	"
5	"	" "	"	"	78.0	---	"	"	"	1,100	1/2" ø	"
6	"	" "	"	"	74.0	---	"	"	"	"	1" ø	"
7	"	" "	"	"	74.0	---	$1.2(10^7)$	"	"	380	1 3/4"ø	"
8	"	4340 Steel. Notch,-semi-circ. groove, R = 0.01". Failure - visible crack.	2.0	"	51.7	---	$3(10^7)$	"	"	2,100	1/8" ø	"
9	"	4340 Steel. Notch,-semi-circ. groove, R = 0.02". Failure - visible crack.	"	"	48.0	---	"	"	"	3,600	1/4" ø	"
10	"	4340 Steel. Notch,-semi-circ. groove, R = 0.04". Failure - visible crack.	"	"	48.0	---	"	"	"	1,100	1/2" ø	"
11	"	4340 Steel. Notch-semi-circ. groove, R - 0.08". Failure - visible crack.	"	"	46.0	---	"	"	"	"	1" ø	"
12	"	4340 Steel. Notch,-semi-circ. groove, R - 0.14". Failure - visible crack.	"	"	42.0	---	$1.2(10^7)$	"	"	380	1 3/4"ø	"

Table II. SAE Steels 4340 and 4350 (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
1	167.8	153.7	17.6	55.2	Rc 38	C-0.35, Mn-0.83, P-----, S-----, Si-0.27, Cr-0.77, Ni-1.82, Mo-0.37	1553°F 2 hrs., OQ; 1067°F 16 hrs., OQ.
2	103.5	83.1	27.5	62.2	RB 98	"	1553°F 2 hrs., OQ; 1112°F 16 hrs., OQ.
3	163.7	156	16.1 (2")	55.6	Rc 36	C-0.385, Mn-0.78, P-0.010, S-0.018, Si-----, Cr-0.74, Ni-1.80, Mo-0.25	1525°F 1 hr., OQ; 1010°F 1 hr., OQ(?).
4	"	"	"	"	"	"	"
5	"	"	"	"	"	"	"
6	"	"	"	"	"	"	"
7	"	"	"	"	"	"	1525°F 1 hr., OQ; 1000°F 1-1/2 hr., OQ.
8	"	"	"	"	"	"	1525°F 1 hr., OQ; 1010°F 1 hr., OQ.
9	"	"	"	"	"	"	"
10	"	"	"	"	"	"	"
11	"	"	"	"	"	"	"
12	"	"	"	"	"	"	1525°F 1 hr., OQ; 1000°F 1-1/2 hr., OQ(?).

Table II. SAE Steels 4340 and 4350 (Continued)

Item	Ref.	Description	Fatigue Properties					Testing Machine			Specimen	
			K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Type	Kind of Test	Speed cpm	Size	Surface Finish
13	18,19, 20	4340 Steel. Notch- R=0.180" S_e extrapolated, for K_t = 1.0, as 89 ksi.	1.20	No	72	---	10^7	Push-Pull	Axial	1,800 or 40 to 120	0.400"Ø	-----
14	"	4340 Steel. Notch- R=0.180" S_e extrapolated, for K_t = 1.0, as 93 ksi.	"	"	78	---	"	"	"	"	"	-----
15	"	4340 Steel. Notch- R=0.180" S_e extrapolated, for K_t = 1.0, as 98 ksi.	"	"	82	---	"	"	"	"	"	-----
16	"	4340 Steel. Notch- R=0.180" S_e extrapolated, for K_t = 1.0, as 118 ksi.	"	"	98	---	"	"	"	"	"	-----
17	21	4340 Steel. Longit. Specimens. Low RAT. Tested by Staircase Method, per ref. (2).	1.0	No	67.0	1.7	10^7	R.R. Moore	Rotating Bending	-----	0.300"Ø	Machine Polish
18	"	4340 Steel. Transv. Specimens. Low RAT. Tested by Staircase Method, per ref. (2).	"	"	46.3	2.9	"	"	"	-----	"	"
19	"	4340 Steel. Longit. Specimens. High RAT. Tested by Staircase Method, per ref. (2).	"	"	61.8	2.0	"	"	"	-----	"	"
20	"	4340 Steel. Transv. Specimens. High RAT. Tested by Staircase Method, per ref. (2).	"	"	52.5	1.6	"	"	"	-----	"	"
21	22	4340 Steel.	1.0	No	70	---	$1.5(10^7)$	Schenck 20 Ton	Axial	2000 to 2500	0.400"	10 micro-inch
22	"	"	"	57.5	57.5	---	"	"	"	"	"	"
23	"	"	"	120	25	---	"	"	"	"	"	"

Table II. SAE Steels 4340 and 4350 (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
13	189.2	179.5	10.7 (1")	---	Rc 41	-----	-----
14	220	208	10.5	---	Rc 46	-----	-----
15	254.5	230	8.5	---	Rc 50	-----	-----
16	283	241	8.5	---	Rc 54	-----	-----
17	125	107	---	66.2	--	C-0.34, Mn-0.71, P-0.018, S-0.023, Si-0.26 Cr-0.76, Ni-1.84, Mo-0.35	Normal at 1700°F, Quench from 1525°F; 1170°F 10 hrs., Stress Relieve 1000°F 1 hr.
18	"	"	---	22.8	--	"	"
19	122	106	---	63.5	--	C-0.31, Mn-0.71, P-0.012, S-0.018, Si-0.28, Cr-0.74, Ni-1.84, Mo-0.36	"
20	"	"	---	58.4	--	"	"
21	158.5	146.9 0.2%	15.0 4D	52.4	--	C-0.414, Mn-0.79, P-0.024, S-0.014, Si-0.029, Cr-0.77, Ni-1.76, Mo-0.27	1525°F 1-1/2 hrs., OQ; Temper at 1150°F 1-1/2 hrs., AC.
22	"	"	"	"	--	"	"
23	"	"	"	"	--	"	"

Table II. SAE Steels 4340 and 4350 (Continued)

Item	Ref.	Description	Fatigue Properties K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Testing Machine Type	Kind of Test	Speed cpm	Specimen Size	Surface Finish
24	22	4340 Steel. 60° V-notch, R=0.01" Notched Tensile Strength = 190 ksi. Notched R.A. = 11.2%.	3.3	No	30	---	$1.5(10^7)$	Schenck 20 Ton	Axial	2000 to 2500	0.400"	-----
25	"	"	"	28.7	28.7	---	"	"	"	"	"	-----
26	"	"	"	150	6.5	---	"	"	"	"	"	-----
27	23	4340 Steel.	1.0	No	87±	---	10^7	Cantilever	Reversed Bending	10,000	0.11"ϕ	2/0 Emery
28	"	4340 Steel. 41° V-notch, R=0.01"	High	"	38±	---	"	"	"	"	0.13"ϕ	
29	24	4340 Steel.	1.0	No	95	---	10^7	R.R. Moore	Rotating Bending	3450 90	-----	-----
30	"	"	"	"	87	---	"	"	"	"	-----	-----
31	"	"	"	"	84	---	"	"	"	"	-----	-----
32	"	"	"	"	76	---	"	"	"	"	-----	-----
33	"	"	"	"	70	---	"	Schenck	Axial	2200	-----	-----
34	"	" 60° V-notch, R=0.010"	2.8	"	45	---	"	R.R. Moore	Rotating Bending	3450 90	-----	-----
35	"	" "	"	"	43	---	"	"	"	"	-----	-----
36	"	" "	"	"	39	---	"	"	"	"	-----	-----
37	"	" "	3.6	"	30	---	"	Schenck	Axial	2200	-----	-----
38	"	" Smooth.	1.0	57	57	---	"	"	"	"	-----	-----
39	"	" 60° V-notch, R-0.010"	3.6	28	28	---	"	"	"	"	-----	-----
40	25	4340 Steel.	1.0	No	86	8.0	10^7	R.R. Moore	Rotating Bending	10,600	0.300"ϕ	-----

Table II. SAE Steels 4340 and 4350 (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
24	158.5	146.9 0.2%	15.0 4D	52.4	--	C-0.414, Mn-0.79, P-0.024, S-0.014 Si-0.029, Cr-0.77, Ni-1.76, Mo-0.27	1525°F 1-1/2 hrs., OQ; Temper at 1150°F 1-1/2 hrs., AC.
25	"	"	"	"	--	"	"
26	"	"	"	"	--	"	"
27	150.4	142.2	18.2 (2")	61	Bhn 322	C-0.39, Mn-0.66, P-0.012, S-0.018 Cr-0.72, Ni-1.72, Mo-0.35	1600°F, OQ from 1500°F at 1150°F.
28	"	"	"	"	"	"	"
29	220.8	----	---	---	---	C-0.35/0.45, Mn-0.60/0.80, P-0.040, S-0.050, Cr-0.60/0.90, Ni-1.65/2.00, Mo-0.20/0.30	-----
30	195	----	---	---	---	"	-----
31	188	----	---	---	---	"	-----
32	158.5	----	---	---	---	"	-----
33	"	----	---	---	---	"	-----
34	220.8	----	---	---	---	"	-----
35	195	----	---	---	---	"	-----
36	158.5	----	---	---	---	"	-----
37	"	----	---	---	---	"	-----
38	"	----	---	---	---	"	-----
39	"	----	---	---	---	"	-----
40	160 Nominal	----	---	---	Vickers 360	-----	-----

Table II. SAE Steels 4340 and 4350 (Continued)

Item	Ref.	Description	Fatigue Properties					Testing Machine			Specimen	
			K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Type	Kind of Test	Speed cpm	Size	Surface Finish
41	26	4340 Steel. Grain Size, McQ-E 7 to 8.	1.0	0	88	---	10^7	Krouse	Const.Ampl. Bending	1700	0.26"ϕ	3/0 Emery
42	"	"	"	40	92	---	"	"	"	"	"	"
43	"	"	"	80	85	---	"	"	"	"	"	"
44	"	"	"	120	86	---	"	"	"	"	"	"
45	"	"	"	160	80	---	"	"	"	"	"	"
46	"	4340 Steel. 60° V-notch, 0.03" deep, R = 0.01".	2.6	0	40	---	"	"	"	"	0.2" ϕ	-----
47	"	" "	"	40	38	---	"	"	"	"	"	-----
48	"	" "	"	80	32	---	"	"	"	"	"	-----
49	"	" "	"	120	25	---	"	"	"	"	"	-----
50	"	" "	"	160	27	---	"	"	"	"	"	-----
51	"	4340 Steel. Smooth.	1.0	0	Tors. 56	---	"	"	Const. Ampl.Tors.	"	0.26"ϕ	3/0
52	"	" "	"	Tors. 40	Tors. 53	---	"	"	"	"	"	"
53	"	" "	"	Tors. 60	Tors. 57	---	"	"	"	"	"	"
54	"	4340 Steel. 60° V-notch, R = 0.01".	1.65	0	Tors. 38	---	"	"	"	"	0.2" ϕ	-----
55	"	" "	"	Tors. 20	Tors. 37	---	"	"	"	"	"	-----
56	"	" "	"	Tors. 40	Tors. 35	---	"	"	"	"	"	-----

Table II. SAE Steels 4340 and 4350 (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
41	171.6	158.1 to 159.3	13	55.6	Rc 36.7 to 39.0	C-0.40, Mn-0.74, P-0.015, S-0.030, Cr-0.82, Ni-1.79, Mo-0.26	Norm. from 1650°F, OQ, from 1550 to 1600°F, 2 hrs. at 1040 to 1050°F, Cooled to 500°F.
42	"	"	"	"	"	"	"
43	"	"	"	"	"	"	"
44	"	"	"	"	"	"	"
45	"	"	"	"	"	"	"
46	"	"	"	"	"	"	"
47	"	"	"	"	"	"	"
48	"	"	"	"	"	"	"
49	"	"	"	"	"	"	"
50	"	"	"	"	"	"	"
51	Torsion 142.5	Torsion 108	--	---	---	"	"
52	"	"	--	---	---	"	"
53	"	"	--	---	---	"	"
54	"	"	--	---	---	"	"
55	"	"	--	---	---	"	"
56	"	"	--	---	---	"	"

Table II. SAE Steels 4340 and 4350 (Continued)

Item	Ref.	Description	Fatigue Properties K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Testing Machine Type	Kind of Test	Speed cpm	Specimen Size	Surface Finish
57	27, 28	4340 Steel. Air melt, electric furnace. Smooth	1.0	No	69	4.4	10^7	R.R. Moore	Rotating Bending	10,000	0.230"ø	2-5 microin.
58	"	4340 Steel. Air melt, electric furnace. 60° V-notch, R=0.010".	2.6	"	32	1.6	"	"	"	"	"	"
59	"	4340 Steel. Air melt, electric furnace. Smooth	1.0	"	85	6.7	"	"	"	"	"	"
60	"	4340 Steel. Air melt, electric furnace. 60° V-notch, R=0.010".	2.6	"	41	2.0	"	"	"	"	"	"
61	"	4340 Steel. Air melt, electric furnace. Smooth	1.0	"	96	8.5	"	"	"	"	"	"
62	"	4340 Steel. Air melt, electric furnace. 60° V-notch, R=0.010".	2.6	"	50	6.6	"	"	"	"	"	"
63	29	4340 Steel. Air melt, electric furnace. Smooth	1.0	No	90	5.8	10^7	R.R. Moore	Rotating Bending	11,000	0.230"ø	2-5 microin.
64	"	4340 Steel. Air melt, electric furnace. 60° V-notch, R=0.010".	2.6	"	47	1.9	"	"	"	"	"	"
65	"	4340 Steel. Vacuum melted steel. Smooth	1.0	"	100	5.5	"	"	"	12,000	"	"
66	"	4340 Steel. Vacuum melted steel. 60° V-notch, R=0.010".	2.6	"	40	2.8	"	"	"	"	"	"
67	"	4340 Steel. Consumable Electrode Steel, Prot Tested.	1.0	"	124 to 126	5.4±	Prot Tests	"	"	10,000 to 12,000	"	"
68	30	4340 Steel. Air melt, electric furnace; transverse specimens from 3 inch rounds, forged flat.	1.0	No	67 Transverse	4.2	10^7	R.R. Moore	Rotating Bending	11,000	0.230"ø	2-5 microin.
69	"	"	"	"	84 Transverse	4.5	"	"	"	"	"	"

Table II. SAE Steels 4340 and 4350 (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
57	144	131	21	60	Rc 30.4	C-0.395, Mn-0.76, P-0.008, S-0.016, Si-0.31, Ni-1.78, Cr-0.84, Mo-0.23	Norm. 1600°F, 4 hrs., AC; Hard. 1525°F, 2 hrs., OQ; Temp. 1150°F, 4 hrs., AC. Stress Relieve 1100°F, 2 hrs.
58	"	"	"	"	"	"	"
59	192	184	15	50	Rc 41.3	"	Norm. 1600°F, AC; Hard. 1525°F, 2 hrs., OQ; Temp. 875°F, 4 hrs., AC. Stress Relieve 700°F, 2 hrs.
60	"	"	"	"	"	"	"
61	268	250	11	43	51.6	"	Norm. 1600°F 4 hrs.,AC; Hard. 1475°F 4 hrs.,OQ; Temp. 450°F 8 hrs.,AC; Stab. 250°F,24 hrs.,AC;Stress Rel.400°F,4 hrs.
62	"	"	"	"	"	"	"
63	238	234	12	45	48.1	"	Norm. 1600°F 2 hrs.,AC; Austen. 1525°F 1.5 hrs.,OQ; Temp. 650°F 4 hrs.,AC; Stress Relieve 550°F, 4 hrs.
64	"	"	"	"	"	"	"
65	188	172	13.8	52	38.6	C-0.41, Mn-0.69, P-----, S-----, Si-0.33, Ni-1.77, Cr-0.89, Mo-0.22	Norm. 1600°F, 4 hrs., AC; Austen. 1525°F 2 hrs.,OQ; Temp. 875°F,4 hrs.,AC; Stress Relieve 700°F, 2 hrs.
66	"	"	"	"	"	"	"
67	298	224	11.4	36	54	C-0.42, Mn-0.67, P-0.014, S-0.023 Si-0.32, Ni-1.88, Cr-0.79, Mo-0.29	Norm. 1600°F,1 hr.,AC; Austen. 1475°F, 1 hr.,OQ; Temp. 350°F,2 hrs.,AC; Stab. 250°F,24 hrs.,AC;Stress Rel.300°F,2 hrs.
68	138	128 Transverse	17.8	47	---	C-0.395, Mn-0.76, P-0.008, S-0.016, Si-0.31, Ni-1.78, Cr-0.84, Mo-0.23	Norm. 1600°F, 4 hrs.,AC; Hard. 1525°F, 2 hrs.,OQ; Temp. 1150°F,4 hrs.,AC. Stress Relieve 1100°F, 2 hrs.
69	190	182 Transverse	11.9	35	---	"	Norm. 1600°F,AC; Hard. 1525°F, 2 hrs., OQ; Temp. 875°F, 4 hrs., AC. Stress Relieve 700°F, 2 hrs.

Table II. SAE Steels 4340 and 4350 (Continued)

Item	Ref.	Description	Fatigue Properties K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Testing Machine Type	Kind of Test	Speed cpm	Specimen Size	Surface Finish
70	30	4340 Steel. Air melt, electric furnace; transverse specimens from 3 inch rounds, forged flat.	1.0	No	84 Transverse	7.6	10^7	R.R. Moore	Rotating Bending	11,000	0.230"ϕ	2-5 microin.
71	"	"	"	"	86 Transverse	7.7	"	"	"	"	"	"
72	5	Hot-Rolled 4340 Steel. Smooth	1.0	"	75.5	---	10^7	R.R. Moore	Rotating Bending	10,000	0.220"ϕ	Lapped
73	"	" 60° V-notch, R = 0.015"	2.2	"	35.0	---	"	"	"	"	"	"
74	"	" Smooth	1.0	"	96.5	---	"	"	"	"	"	"
75	"	" 60° V-notch, R = 0.015"	2.2	"	45.9	---	"	"	"	"	"	"
76	14	4340 Steel. Longitudinal	1.0	No	97.0	5.9	Prot	Krouse	Rotating Cant.	8,000	0.223"ϕ	4 micro-in.
77	"	" Transverse. Same heat as Item 76.	"	"	94.4	4.8	"	"	"	"	"	"
78	"	" Longitudinal	"	"	88.1	7.0	"	"	"	"	"	"
79	"	" Transverse. Same heat as Item 78.	"	"	84.9	8.2	"	"	"	"	"	"
80	"	" Longitudinal	"	"	86.0	5.5	"	"	"	"	"	"
81	"	" Transverse. Same heat as Item 80.	"	"	87.3	5.3	"	"	"	"	"	"
82	"	" Longitudinal	"	"	84.5	4.2	"	"	"	"	"	"
83	"	" Transverse. Same heat as Item 82.	"	"	81.6	6.8	"	"	"	"	"	"
84	"	" Longitudinal	"	"	88.8	7.3	"	"	"	"	"	"

Table II. SAE Steels 4340 and 4350 (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
70	236	211 Transverse	9.3	28	---	C-0.395, Mn-0.76, P-0.008, S-0.016, Si-0.31, Ni-1.78, Cr-0.84, Mo-0.23	Norm. 1600°F, 2 hrs.,AC; Austen. 15[illegible]5°F, 1.5 hrs.,OQ; Temp. 650°F, 4 hrs., AC; Stress Relieve 550°F, 4 hrs.
71	270	227 Transverse	9.0	24	---	"	Norm. 1600°F, 4 hrs.,AC; Hard. 1475°F, 4 hrs.,OQ; Temp. 450°F,8 hrs.,AC; Stab. 250°F,24 hrs.,AC;Stress Rel. 400°F,4 hrs.
72	124.6	98.9	23.5	63.8	Bhn 262	C-0.39, Mn-0.76, Si-0.30, P-0.035, S-0.013, Cr-0.78, Ni-1.79, Mo-0.25	Normalized 1650°F, Tempered 1200°F.
73	"	"	"	"	"	"	"
74	168.4	158.1	17.0	56.3	375	"	Quenched 1500°F, Tempered 1025°F.
75	"	"	"	"	"	"	"
76	207 Long.	196 Long.	11.7 Long.	49 Long.	Rc 40 Long.	C-0.40, Mn-0.68, P-0.015, S-0.018, Si-0.26, Ni-1.74, Cr-0.79, Mo-0.24	Salt bath 1550°F 15 min., OQ; Temper 30 min. to Rc 41±2 on 13/32" ø
77	201 Trans.	191 Trans.	9.8 Trans.	37 Trans.	40 Trans.	"	"
78	229 Long.	219 Long.	10.7 Long.	47 Long.	42 Long.	C-0.44, Mn-0.74, P-0.012, S-0.015, Si-0.25, Ni-1.73, Cr-0.74, Mo-0.25	"
79	228 Trans.	218 Trans.	10.0 Trans.	37 Trans.	42 Trans.	"	"
80	199 Long.	189 Long.	11.7 Long.	44 Long.	40 Long.	C-0.40, Mn-0.80, P-0.011, S-0.010, Si-0.30, Ni-1.77, Cr-0.74, Mo-0.27	1550°F, controlled atmos., 1 hr., OQ; Temper 850°F, neutral salt, 40 min.
81	198 Trans.	188 Trans.	12.3 Trans.	47 Trans.	40 Trans.	"	"
82	201 Long.	189 Long.	11.2 Long.	38 Long.	40 Long.	C-0.39, Mn-0.81, P-0.012, S-0.019, Si-0.26, Ni-1.79, Cr-0.84, Mo-0.28	1550°F, neutral salt, 15 min., OQ; Temper 850°F, neutral salt, 30 min.
83	200 Trans.	186 Trans.	11.5 Trans.	38 Trans.	39 Trans.	"	"
84	201 Long.	190 Long.	11.7 Long.	41 Long.	41 Long.	C-0.40, Mn-0.80, P-0.012, S-0.018, Si-0.30, Ni-1.80, Cr-0.87, Mo-0.27	1550°F, neutral salt, 15 min., OQ; Temper 850°F, neutral salt, 20 min.

Table II. SAE Steels 4340 and 4350 (Continued)

Item	Ref.	Description	Fatigue Properties					Testing Machine			Specimen	
			K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Type	Kind of Test	Speed cpm	Size	Surface Finish
85	14	4340 Steel. Transverse. Same heat as Item 84.	1.0	No	85.2	7.5	Prot	Krouse	Rotating Cant.	8,000	0.223"ϕ	4 micro-in.
86	29	4350 Steel. Smooth	1.0	No	100	4.4	10^7	R.R. Moore	Rotating Bending	12,000 130	0.230"ϕ	3-5 microin.
87	"	" 60° V-notch, R = 0.010".	2.6	"	60	4.9	"	"	"	"	"	"
88	14	4350 Steel. Longitudinal	1.0	No	98.8	7.5	Prot	Krouse	Rotating Cantil.	8,000	0.223"ϕ	4 micro-in.
89	"	" Transverse. Same heat as Item 88.	"	"	95.6	8.0	"	"	"	"	"	"
90	"	" Longitudinal	"	"	82.7	7.4	"	"	"	"	"	"
91	"	" Transverse. Same heat as Item 90.	"	"	79.0	8.1	"	"	"	"	"	"
92	"	" Longitudinal	"	"	80.0	9.7	"	"	"	"	"	"
93	"	" Transverse. Same heat as Item 92.	"	"	75.8	8.0	"	"	"	"	"	"
94	11	" Longitudinal	1.0	No	79.4	9.6	Prot	Krouse	Rotating Cantil.	8,000	0.223"ϕ	4 micro-in.
95	"	" Transverse. Same heat as Item 94.	"	"	84.3	7.4	"	"	"	"	"	"

Table II. SAE Steels 4340 and 4350 (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
85	203 Trans.	197 Trans.	10.3 Trans.	46 Trans.	41 Trans.	C-0.40, Mn-0.80, P-0.012, S-0.018, Si-0.30, Ni-1.80, Cr-0.87, Mo-0.27	1550°F, neutral salt, 15 min., OQ; Temper, 850°F, neutral salt, 20 min.
86	300.6	248.4	9.2	32.3	Rc 52	C-0.50, Mn-0.73, P-0.014, S-0.013, Si-0.30, Ni-1.84, Cr-0.76, Mo-0.24	1600°F, 4 hrs.,AC; 1500°,2 hrs., OQ; Temper 450°F,6 hrs.,AC; 450°F,6 hrs., AC; Stabilize 250°F,24 hrs.,AC; Stress Relief after finish machining 400°F, 4 hrs., FC.
87	"	"	"	"	"	"	
88	215 Long.	205 Long.	11.2 Long.	39 Long.	45 Long.	C-0.54, Mn-0.78, P-0.017, S-0.014, Si-0.31, Ni-1.74, Cr-0.88, Mo-0.30	Salt bath 1550°F, 15 min., OQ; Tempered 30 min. to RC 41±2 on 13/32" ϕ
89	214 Trans.	206 Trans.	9.5 Trans.	35 Trans.	45 Trans.	"	"
90	218 Long.	211 Long.	10.0 Long.	40 Long.	42 Long.	C-0.52, Mn-0.74, P-0.016, S-0.012, Si-0.32, Ni-1.79, Cr-0.81, Mo-0.27, Cu-0.18	"
91	217 Trans.	211 Trans.	9.3 Trans.	41 Trans.	43 Trans.	"	"
92	208 Long.	198 Long.	11.7 Long.	36 Long.	41 Long.	C-0.48, Mn-0.67, P-0.011, S-0.013, Si-0.29, Ni-1.72, Cr-0.75, Mo-0.23, Cu-0.16	Salt bath 1550°F 15 min., OQ; Tempered 900°F, 30 min.
93	207 Trans.	196 Trans.	10.7 Trans.	37 Trans.	42 Trans.	"	"
94	214 Long.	204 Long.	10.0 Long.	46 Long.	42 Long.	C-0.49, Mn-0.76, P-0.015, S-0.014, Si-0.29, Ni-1.79, Cr-0.80, Mo-0.23, Cu-0.15	Salt bath 1550°F, 15 min., OQ; Tempered, 900°F, 30 min.
95	214 Trans.	202 Trans.	8.0 Trans.	49 Trans.	42 Trans.	"	"

Table III. SAE Steels 52100 to 98B40

Item	Ref.	Description	Fatigue Properties K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Testing Machine Type	Kind of Test	Speed cpm	Specimen Size	Surface Finish
1	32	"Essentially type 52100 Steel with Added Vanadium"	1.0	No	147	---	10^7	R.R. Moore Cant.	Rot. Bending	10,000	0.230"ϕ	35 micro inch
2	"	"	"	"	140	---	"	"	"	"	"	15 "
3	"	"	"	"	137	---	"	"	"	"	"	5 "
4	"	"	"	"	136	---	"	"	"	"	"	-----
5	"	"	"	"	128	---	"	"	"	"	"	5 micro inch
6	"	"	"	"	127	---	"	"	"	"	"	5 "
7	"	"	"	"	65	---	"	Vib. Cant.	Bending	1,600	0.12" x 1.25"	20 "
8	"	"	"	"	59	---	"	"	"	"	"	10 "
9	"	"	"	"	45	---	"	"	"	"	"	35-40 "
10	"	"	"	"	47	---	"	"	"	"	"	10 "
11	"	"	"	"	122	---	"	R.R. Moore Cant.	Rot. Bending	10,000	0.230"ϕ	7 "
12	"	"	"	"	120	---	"	"	"	"	"	5 "
13	"	"	"	"	102	---	"	"	"	"	"	45 "
14	"	"	"	"	102	---	"	"	"	"	"	20 "
15	"	"	"	"	94	---	"	"	"	"	"	5 "

Table III. SAE Steels 52100 to 98B40 (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
1	---	---	---	---	Rc 59	C-1.00, Cr-1.40, Mn-0.20, V-0.20, Si-0.25	OQ from 1550°F; Temp. 400°F, 1 hr.
2	---	---	---	---	"	"	"
3	---	---	---	---	"	"	"
4	---	---	---	---	"	"	"
5	---	---	---	---	"	"	"
6	---	---	---	---	"	"	"
7	---	---	---	---	"	"	"
8	---	---	---	---	"	"	"
9	---	---	---	---	"	"	"
10	---	---	---	---	"	"	"
11	---	---	---	---	45	"	OQ from 1550°F; Temp. 850°F, 1 hr.
12	---	---	---	---	"	"	"
13	---	---	---	---	"	"	"
14	---	---	---	---	"	"	"
15	---	---	---	---	"	"	"

Table III. SAE Steels 52100 to 98B40 (Continued)

Item	Ref.	Description	Fatigue Properties					Testing Machine			Specimen	
			K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Type	Kind of Test	Speed cpm	Size	Surface Finish
16	32	"Essentially type 52100 Steel with Added Vanadium".	1.0	No	97	---	10^7	R.R. Moore Cant.	Rot. Bending	10,000	0.230"ϕ	170 micro-inch
17	"	"	"	"	83	---	"	Vib. Cant.	Bending	1,600	0.12" x 1.25"	100 "
18	"	"	"	"	78	---	"	"	"	"	"	90 "
19	"	"	"	"	73	---	"	"	"	"	"	15 "
20	"	"	"	"	60	---	"	"	"	"	"	10 "
21	"	"	"	"	60	---	"	"	"	"	"	7 "
22	"	"	"	"	45	---	"	"	"	"	"	35-40 "
23	"	Regular 52100 Steel.	"	"	80±	---	"	"	"	"	Flat 0.050" Thick	20 "
24	"	"	"	"	85±	---	"	"	"	"	"	20 "
25	"	"	"	"	75±	---	"	"	"	"	"	20 "
26	"	"	"	"	80±	---	"	"	"	"	"	20 "
27	33	Regular 52100 Steel.	"	"	130±	---	"	Rot. Cant.	Bending	13,000	----	3 "
28	"	"	"	"	140±	---	"	"	"	"	----	" "
29	"	"	"	"	135±	---	"	"	"	"	----	" "
30	"	"	"	"	140±	---	"	"	"	"	----	" "

Table III. SAE Steels 52100 to 98B40 (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
16	---	---	---	---	Rc 45	C-1.00, Cr-1.40, Mn-0.20, V-0.20, Si-0.25	OQ from 1550°F; Temp. 850°F, 1 hr.
17	---	---	---	---	"	"	"
18	---	---	---	---	"	"	"
19	---	---	---	---	"	"	"
20	---	---	---	---	"	"	"
21	---	---	---	---	"	"	"
22	---	---	---	---	"	"	"
23	---	---	---	---	63.4	-----	OQ from 1537°F; Temp. 347°F, 1 hr.
24	---	---	---	---	62.1	-----	"
25	---	---	---	---	63.0	-----	"
26	---	---	---	---	62.2	-----	"
27	---	---	---	---	63.5	-----	OQ; Temp. 347°F, 45 min.
28	---	---	---	---	63.9	-----	Q 338°F, Salt, 3 min.; Temp. 347°F, 45 min.
29	---	---	---	---	61.8	-----	Q 428°F, Salt, 90 min.; Temp. 347°F, 45 min.
30	---	---	---	---	61.7	-----	Q 428°F, 90 min.; Temp. 464°F, 4 hrs.

Table III. SAE Steels 52100 to 98B40 (Continued)

Item	Ref.	Description		Fatigue Properties: Kt	S_m ksi	Se ksi	St. Dev.	Life, Cycles	Testing Machine: Type	Kind of Test	Speed cpm	Specimen: Size	Surface Finish
31	33	Regular 52100 Steel.		1.0	No	140±	---	10^7	Rot. Cant.	Bending	13,000	----	3 micro inch
32	"	"		"	"	130±	---	"	"	"	"	----	3 "
33	5	Cast 8630 Steel.	Smooth	1.0	"	54.0	---	"	"	"	"	----	" "
34	"	"	60° V-notch R = 0.015"	2.2	"	33.1	---	"	"	"	"	"	" "
35	"	"	Smooth	1.0	"	64.9	---	"	"	"	"	"	" "
36	"	"	60° V-notch R = 0.015"	2.2	"	38.6	---	"	"	"	"	"	" "
37	"	Hot Rolled 8640 Steel.	Smooth	1.0	"	64.5	---	"	"	"	"	"	" "
38	"	"	60° V-notch R = 0.015"	2.2	"	32.0	---	"	"	"	"	"	" "
39	"	"	Smooth	1.0	"	77.8	---	"	"	"	"	"	" "
40	"	"	60° V-notch R = 0.015"	2.2	"	37.4	---	"	"	"	"	"	" "
41	8	AISI 14B50 Steel.	Smooth	1.0	"	61	---	"	"	"	7,200	0.25"ϕ	2/0 Emery
42	"	"	Semi-circ. notch R = 0.050"	Yes	"	39	---	"	"	"	"	0.25"ϕ	-----
43	13	98B40 Steel	Smooth	1.0	No	113±	---	10^7	-----	Rot. Bend.	-----	0.188"ϕ	Mech. Polish
44	"	"	60° V-notch 0.038" deep R = 0.0007"	8.0	"	60±	---	"	-----	"	-----	"	-----

Table III. SAE Steels 52100 to 98B40 (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
31	---	---	---	---	Rc 58.5	-----	Q 518°F, Salt, 1 hr.; Temp. 347°F, 45 min.
32	---	---	---	---	59.4	-----	OQ, 30 sec.; Temp. 572°F, 45 min.
33	110.5	85.6	19.0	53.7	223	C-0.29, Mn-0.73, Si-0.45, P-0.026, S-0.035, Cr-0.52, Ni-0.57, Mo-0.23	Normalized 1650°F, Tempered 1200°F.
34	"	"	"	"	"	"	"
35	137.5	125.8	14.8	34.5	286	"	Quenched 1550°F, Tempered 1200°F.
36	"	"	"	"	"	"	"
37	108.5	82.5	24.0	60.2	217	C-0.42, Mn-0.89, Si-0.30, P-0.040, S-0.014, Cr-0.57, Ni-0.61, Mo-0.22	Normalized 1650°F, Tempered 1200°F.
38	"	"	"	"	"	"	"
39	138.2	124.2	21.5	65.6	286	"	Quenched 1525°F, Tempered 1200°F.
40	"	"	"	"	"	"	"
41	271.5	242.0	9.25 2"	45.8	Rc 51	C-0.52, Mn-0.84, P-0.011, S-0.030, Si-0.27, B-0.0005	1550°F, 10 min., OQ; Temper 550°F.
42	"	"	"	"	"	"	"
43	302.6	235±	8.5	33±	---	C-0.46, Mn-0.79, P-0.017, S-0.017, Si-0.35, Ni-0.86, Cr-0.81, Mo-0.19, B-?	1550°F, OQ; Tempered 400°F.
44	"	"	"	"	---	"	"

Table III. SAE Steels 52100 to 98B40 (Continued)

Item	Ref.	Description		K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Type	Kind of Test	Speed cpm	Size	Surface Finish
				Fatigue Properties					Testing Machine			Specimen	
45	13	98B40 Steel.	Smooth	1.0	No	102±	---	10^7	-----	Rotating Bending	-----	0.188"ϕ	Mech. Polish
46	"	"	60° V-notch 0.038" deep R = 0.0007"	8.0	"	50±	---	"	-----	"	-----	"	------
47	"	"	Smooth	1.0	"	94±	---	"	-----	"	-----	"	Mech. Polish
48	"	"	60° V-notch 0.038" deep R = 0.0007"	8.0	"	50±	---	"	-----	"	-----	"	------
49	"	"	Smooth	1.0	"	83±	---	"	-----	"	-----	"	Mech. Polish
50	"	"	60° V-notch 0.038" deep R = 0.0007"	8.0	"	40±	---	"	-----	"	-----	"	------
51	"	"	Smooth	1.0	"	90±	---	"	-----	"	-----	"	Mech. Polish
52	"	"	60° V-notch 0.038" deep R = 0.0007"	8.0	"	39±	---	"	-----	"	-----	"	------

Table III. SAE Steels 52100 to 98B40 (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
45	284	245±	9±	33±	---	C-0.46, Mn-0.79, P-0.017, S-0.017, Si-0.35, Ni-0.86, Cr-0.81, Mo-0.19, B-?	1550°F, OQ; Tempered 500°F.
46	"	"	"	"	---	"	"
47	270	235±	9±	34±	---	"	1550°F, OQ; Tempered 575°F.
48	"	"	"	"	---	"	"
49	245	225±	8.5±	34±	---	"	1550°F, OQ; Tempered 650°F.
50	"	"	"	"	---	"	"
51	204	195±	10±	35±	---	"	1550°F, OQ; Tempered 800°F.
52	"	"	"	"	---	"	"

Table IV. Special Steels

Item	Ref.	Description		Fatigue Properties K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Testing Machine Type	Kind of Test	Speed cpm	Specimen Size	Surface Finish
1	34	"Tricent" Steel. (Electric Furnace)	Longitudinal Specimens	1.0	No	135±	---	10^6	Sonntag	Push-Pull	1800	0.200"ø	Mech. Polish
2	"	"	Transverse Specimens	"	"	85±	---	"	"	"	"	"	"
3	"	"	Longitudinal Specimens	"	"	120±	---	"	"	"	"	"	"
4	"	"	Transverse Specimens	"	"	90±	---	"	"	"	"	"	"
5	"	"	Longitudinal Specimens	"	"	120±	---	"	"	"	"	"	"
6	"	"	Transverse Specimens	"	"	85±	---	"	"	"	"	"	"
7	29	"	Longitudinal Specimens (Prot Tested)	"	"	115-117	5.6±	Prot	R.R. Moore	Rotating Bending	11,000	0.230"ø	2-5 micro-inch
8	"	"Tricent" Steel. (Consumable Electrode)	"	"	"	116-118	4.1±	"	"	"	"	"	"
9	"	"Super Hy-Tuf" (Consumable Electrode)	"	"	"	118-120	6.1±	"	"	"	"	"	"
10	34	Cruc. UHS-260 Steel (Electric Furnace)	Longitudinal Specimens	"	"	90±	---	10^6	Sonntag	Push-Pull	1800	0.200"ø	Mech. Polish
11	"	"	Transverse Specimens	"	"	85±	---	"	"	"	"	"	"
12	"	Super TM-2 Steel. (Electric Furnace)	Longitudinal Specimens	"	"	130±	---	"	"	"	"	"	"

Table VI. Special Steels (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
1	295±	---	---	---	---	C-0.39, Mn-0.74, P-0.014, S-0.014, Si-1.54, Ni-1.83, Cr-0.83, Mo-0.38, V-0.07	1600°F, OQ; Temper 400°F, 4 hrs.; AC (No stress relief mentioned)
2	"	---	---	---	---	"	"
3	280±	---	---	---	---	"	1600°F, OQ; Temper 550°F, 4 hrs., AC.
4	"	---	---	---	---	"	"
5	275±	---	---	---	---	"	1600°F, OQ; Temper 700°F, 4 hrs., AC.
6	"	---	---	---	---	"	"
7	294	229	11	37	54.2	C-0.40, Mn-0.71, P-0.012, S-0.006, Si-1.64, Ni-1.81, Cr-0.87, Mo-0.38, V-0.08	Normalize 1700°F, 1 hr., AC; Harden 1650°F, 1 hr., OQ; Temper 400°F, 2 hrs AC; Stabilize 250°F, 24 hrs., AC; Stress Relieve 300°F, 2 hrs., AC.
8	304.6	251	10	28.5	54.5	C-0.43, Mn-0.76, P-0.012, S-0.022, Si-1.62, Ni-1.75, Cr-0.79, Mo-0.45, V-0.07	Normalize 1700°F, 1 hr., AC; Harden 1650°F, 1 hr., OQ; Temper 475°F, 2 hrs AC; Stabilize 250°F, 24 hrs., AC; Stress Relieve 300°F, 2 hrs., AC.
9	313.2	267.3	8.2	26	54	C-0.44, Mn-1.29, P-0.011, S-0.021, Si-2.23, Ni----, Cr-1.46, Mo-0.38, V-0.19	Normalize 1700°F, 1 hr., AC; Harden 1700°F, 1 hr., OQ; Temper 700°F, 2 hrs AC; Stabilize 250°F, 24 hrs., AC; Stress Relieve 300°F, 2 hrs., AC.
10	295±	---	---	---	---	C-0.35, Mn-1.20, P-0.023, S-0.017, Ni----, Cr-1.26, Mo-0.32, V-0.20	1700°F, OQ; Temper 550°F, 4 hrs. AC.
11	"	---	---	---	---	"	"
12	270±	---	---	---	---	C-0.41, Mn-0.72, P-0.012, S-0.014, Si-0.61, Ni-2.08, Cr-1.15, Mo-0.44, V----, Cu-0.14	1600°F, OQ; Temper 500°F, 4 hrs., AC.

Table IV. Special Steels (Continued)

Item	Ref.	Description		Fatigue Properties					Testing Machine			Specimen	
				K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Type	Kind of Test	Speed cpm	Size	Surface Finish
13	34	Super TM-2 Steel. Transverse (Electric Furnace) Specimens		1.0	No	85±	---	10^6	Sonntag	Push-Pull	1800	0.200"ϕ	Mech. Polish
14	13	Hy-Tuf (Electric Furnace)	Smooth	1.0	No	90±	---	10^7	------	Rotating Bending	----	0.188"ϕ	Mech. Polish
15	"	"	60° V-notch, 0.038" deep R = 0.0007"	8.0	"	52±	---	"	------	"	----	"	-----
16	"	Super Hy-Tuf	Smooth	1.0	No	100	---	"	------	"	----	"	Mech. Polish
17	"	"	60° V-notch, 0.038" deep R = 0.0007"	8.0	"	42±	---	"	------	"	----	"	-----

Table IV. Special Steels (Continued)

Item	UTS ksi	Static Properties YP ksi	Elong. %	R.A. %	Hard	Chemical Composition	Heat Treatment
13	270±	---	---	---	---	C-0.41, Mn-0.72, P-0.012, S-0.014, Si-0.61, Ni-2.08, Cr-1.15, Mo-0.44, V----, Cu-0.14	1600°F, OQ; Temper 500°F, 4 hrs., AC.
14	243	260±	---	---	---	C-0.285, Mn-1.29, P-0.019, S-0.015, Si-1.58, Ni-1.87, Cr-0.24, Mo-0.40	1575°F, OQ; Temper 500°F.
15	"	"	---	---	---	"	"
16	260	210±	8.5±	33±	---	C-0.41, Mn-1.28, P-0.014, S-0.024, Si-1.77, Cr-1.26, Mo-0.33, V-0.17	1700°F, OQ; Temper 800°F.
17	"	"	"	"	---	"	"

Table V. Heat Resistant Alloys

Item	Ref.	Description		Fatigue Properties					Testing Machine			Specimen	
				K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Type	Kind of Test	Speed cpm	Size	Surface Finish
1	35	Ferrovac WB-49 Steel	Smooth	1.0	No	129±	---	10^7	R.R. Moore	Rotating Bending	10,500	0.230"ϕ	5 micro-inch
2	"	"	60° V-notch R = 0.010"	2.6	"	67±	---	"	"	"	"	"	"
3	"	Ferrovac WB-49, Nitrided	Smooth	1.0	"	132±	12±	"	"	"	"	"	"
4	"	"	60° V-notch R = 0.010"	2.6	"	111±	Small	"	"	"	"	"	"
5	36	GMR-235 Alloy	Smooth	1.0	"	35±	---	2.6×10^7	-----	Axial	3,600	0.250"ϕ	400 Grit
6	"	"	60° V-notch R = 0.010"	3.4	"	22±	---	"	-----	"	"	"	600 Grit
7	37	Halmo Tool Steel	Vacuum Melt Smooth	1.0	No	140	---	10^7	R.R. Moore	Rotating Bending	-----	0.187"ϕ	500 Grit
8	36	Hastelloy R-235 Alloy	Smooth	1.0	"	61±	---	2.6×10^7	-----	Axial	3,600	0.250"ϕ	400 Grit
9	"	"	60° V-notch R = 0.010"	3.4	"	26±	---	"	-----	"	"	"	600 Grit
10	38	H-11 Alloy Bar		1.0	59	59	---	10^6	-----	Axial	-----	-----	-----
11	"	"		2.5	34	34	---	"	-----	"	-----	-----	-----
12	35	H-23 Hot Work Steel	Smooth	1.0	No	108±	7±	10^7	R.R. Moore	Rotating Bending	10,500	0.230"ϕ	5 micro-inch
13	39	Inconel X Alloy	Smooth	1.0	No	57±	---	$2(10^7)$	-----	-----	-----	-----	-----

Table V. Heat Resistant Alloys (Continued)

Item	Static Properties: UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
1	---	---	---	---	Rc 67	C-1.03, Mn-0.42, Si-0.26, Cr-4.30, Co-5.32, Mo-3.94, W-6.84, V-1.74	1500°F, 30 min., 2225°F, 7 min., AC; 1050°F, 2 hrs., AC; 1050°F, 2 hrs., AC; After machining, 1000°F, 2 hrs.
2	---	---	---	---	"	"	"
3	---	---	---	---	"	"	1500°F, 30 min.; 2225°F, 7 min., AC; 1050°F, 2 hrs., AC; 1050°F, 2 hrs., AC; Nitride 975°F, 48 hrs.
4	---	---	---	---	"	"	"
5	64 1650°F	---	18.5 1650°F	---	---	C-0.19, Al-2.95, Ti-2.25, Mo-5.50, Cr-15.7, Fe-10.0, Si-0.20, Mn-0.02, Bi-0.092, Ni-bal.	-----
6	"	---	"	---	---	"	-----
7	370	310	---	---	Rc 62	C-0.59, Mn-0.31, P-0.005, S-0.007, Si-1.10, Cr-4.79, V-0.51, Mo-5.22	Preheat 1500°F; Austen. 2100°F, OQ; Temper 1000°F, 2 hrs.; Retemper 1000°F, 2 hrs.
8	70 1650°F	---	17 1650°F	---	---	C-0.17, S-0.017, Al-2.06, Ti-2.55, Mo-5.31, Cr-15.51, Co-0.27, Fe-9.95, Si-0.22, Mn-0.03, P-0.001, Ni-bal.	2150°F, 1/2 hr., AC.
9	"	---	"	---	---	"	"
10	280-300	---	---	---	---	-----	-----
11	"	---	---	---	---	-----	-----
12	185±	143	---	---	---	C-0.33, Mn-0.45, Si-0.52, Cr-11.49, Ni-0.10, Mo-0.32, W-11.80	1400°F, 30 min.; 2250°F, 5 min., OQ to black,AC; 1100°F 1 hr.,2 hrs.,2 hrs.; After Machining,1000°F,2 hrs.
13	162	92 0.2%	24	30	---	C-0.40, Mn-0.51, P----, S-0.007, Si-0.39, Ni-73.16, Cr-14.61, Cb-1.04, Fe-6.87, Al-0.88, Ti-2.44, Cu-0.03	1550°F, 24 hrs., AC; 1300°F, 20 hrs., AC.

Table V. Heat Resistant Alloys (Continued)

Item	Ref.	Description		Fatigue Properties					Testing Machine			Specimen	
				K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Type	Kind of Test	Speed cpm	Size	Surface Finish
14	38	Inconel X Sheet		1.0	31.5	31.5	---	10^6	-----	Axial	-----	-----	-----
15	40	Inconel X-550 Alloy	Smooth	1.0	No	52±	---	$2x10^7$	Special	Axial	3,600	0.250"ϕ	400 Grit
16	"	"	60° V-notch R = 0.010"	3.4	"	22±	---	"	"	"	"	"	10 micro-inch
17	41	Inconel 713C. Tests at 1700°F.	Smooth	1.0	0	25	---	$2.17x10^7$ 100 hrs.	-----	Axial	3,600	0.20"ϕ	-----
18	"	"	60° V-notch R = 0.010"	2.9	0	33	---	"	-----	"	"	"	-----
19	"	"	Smooth	1.0	28	None	---	100 hrs.	-----	"	-----	"	-----
20	"	"	60° V-notch R = 0.010"	2.9	25	"	---	"	-----	"	-----	"	-----
21	"	"	Smooth	1.0	23	6	---	$2.17x10^7$ 100 hrs.	-----	"	3,600	"	-----
22	"	"	60° V-notch R = 0.010"	2.9	31	7.5	---	"	-----	"	"	"	-----
23	"	"	Smooth	1.0	20	13	---	"	-----	"	"	"	-----
24	"	"	60° V-notch R = 0.010"	2.9	22	15	---	"	-----	"	"	"	-----
25	"	"	Smooth	1.0	10.5	21	---	"	-----	"	"	"	-----
26	"	"	60° V-notch R = 0.010"	2.9	8.5	17	---	"	-----	"	"	"	-----

Table V. Heat Resistant Alloys (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
14	175	---	---	---	---	-----	-----
15	173.5	115.0 0.2%	7	---	Rc 38	C-0.05, Mn-0.73, Si-0.28, S-0.007, Cr-14.92 Ti-2.5, Al-1.16, Fe-6.59, Cu-1.03, Cb + Ta-1.03, Ni-bal.	2150°F, 1 hr., AC; 1600°F, 4 hrs., AC; 1350°F, 4 hrs., AC.
16	"	"	"	---	"	"	"
17	80 1700°F	---	---	---	---	Cr-11.9, Fe-0.86, Si-0.49, Mn-0.13, C-0.11, Mo-5.0, Al-5.6, Ti-0.52, Cb-2.1, Ni-bal.	None. Used in "as cast" condition.
18	"	---	---	---	---	"	"
19	"	---	---	---	---	"	"
20	"	---	---	---	---	"	"
21	"	---	---	---	---	"	"
22	"	---	---	---	---	"	"
23	"	---	---	---	---	"	"
24	"	---	---	---	---	"	"
25	"	---	---	---	---	"	"
26	"	---	---	---	---	"	"

Table V. Heat Resistant Alloys (Continued)

Item	Ref.	Description		Fatigue Properties: K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Testing Machine: Type	Kind of Test	Speed cpm	Specimen: Size	Surface Finish
27	42	Lapalloy Alloy	Smooth	1.0	No	72	---	$2x10^7$	-----	Rotating Cant.	-----	0.250"ø	-----
28	37	M-1 Tool Steel	Vacuum Melt Smooth	1.0	No	130	---	10^7	R.R. Moore	Rotating Bending	-----	0.187"ø	500 Grit
29	"	MV-1 Tool Steel	"	"	"	125	---	"	"	"	-----	"	"
30	35	M-10 Steel.	Smooth	1.0	No	126	13	10^7	R.R. Moore	Rotating Bending	10,500	0.230"ø	5 micro-inch
31	"	"	60° V-notch R = 0.010"	2.6	"	71	5	"	"	"	"	".	"
32	"	M-10 Nitrided.	Smooth	1.0	"	126±	9±	"	"	"	"	"	"
33	"	"	60° V-notch R = 0.010"	2.6	"	136±	---	"	"	"	"	"	"
34	43	N-155 Alloy.	Smooth	1.0	No	53	---	$2(10^7)$	-----	Rotating Cantil.	1,000±	0.2" ø	Polish
35	"	"	60° V-notch R - 0.010"	2.6	"	24	---	"	-----	"	"	0.206"ø	-----
36	38	PH-15-7 Mo Sheet Stainless Steel, Condition RH 950		1.0	43	43	---	10^6	-----	Axial	-----	-----	-----
37	"	"	"	2.5	22.5	22.5	---	"	-----	"	-----	-----	-----
38	"	17-7 PH Sheet Stainless Steel, Condition TH 1050		1.0	43	43	---	"	-----	"	-----	-----	-----
39	"	"	"	2.5	17	17	---	"	-----	"	-----	-----	-----

Table V. Heat Resistant Alloys (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
27	129	112 0.2%	21 2"	68.8	Rc 27-30	C-0.30, Cr-12.20, Mn-1.05, Ni-0.22, Si-0.35, Mo-2.87, P-0.019, S-0.024, V-0.28, Fe-bal.	Forged at 2020°F-2050°F and 1700--1800°F; Stress Relieved 1275°F, 6 hrs.,AC; 200°F 45 min.,500°F 30 min.,1320°F 4 hrs.,AC.
28	370	310	---	---	Rc 62	C-0.80, Mn-0.25, P-0.004, S-0.007, Si-0.32, Cr-3.76, V-1.15, W-1.53, Mo-8.54, Cu-0.01, Ni-0.07	Preheat 1500°F; Austen. 2100°F, OQ; Temper 1000°F, 2 hrs.; Retemper 1000°F, 2 hrs.
29	370	295	---	---	"	C-0.81, Mn-0.26, P-0.004, S-0.007, Si-0.14, Cr-3.97, V-1.07, W-0.01, Mo-4.29, Cu-0.01, Ni-0.05	"
30	---	---	---	---	Rc 61-62	C-0.86, Mn-0.25, Si-0.28, Cr-3.99, V-2.04, Mo-7.98, P-0.015, S-0.006	1450°F,30 min.; 2150°F,5 min.; OQ to black AC; 1100°F,2 hrs.,AC; 1100°F,2 hrs.,AC; After Machining,1000°F in protective atmosphere.
31	---	---	---	---	"	"	"
32	---	---	---	---	---	C-0.86, Mn-0.25, Si-0.28, Cr-3.99 V-2.04, Mo-7.98, P-0.015, S-0.006	Same as above,except not stress relieved, at 1000°F,but nitrided 975°F, 48 hrs.
33	---	---	---	---	---	"	"
34	119	60.5 0.2%	44 2"	---	---	C-0.15, Mn-1.74, Si-0.37, Ni-19.4, Cr-21.7, Mo-2.76, W-1.90, Co-19.0, Cb-0.76, Fe-32.1, N-0.14	1400°F, 16 hrs., AC.
35	"	"	"	---	---	"	"
36	225	---	---	---	---	Cr-15, Ni-7, Mo-2 (Nominal)	Refrigerated, and Hardened at 950°F.
37	"	---	---	---	---	"	"
38	180	---	---	---	---	Cr-17, Ni-7 (Nominal)	Treated, and Hardened at 1050°F.
39	"	---	---	---	---	"	-----

Table V. Heat Resistant Alloys (Continued)

Item	Ref.	Description		Fatigue Properties K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Testing Machine Type	Kind of Test	Speed cpm	Specimen Size	Surface Finish
40	44	Refractaloy 26 Grain Size, ASTM 7-5	Smooth	1.0	No	74	---	10^8	Westing-house Type MD	Cantil. Bending	7,200	0.333"ϕ	Under 10 Microin.
41	"	"	Semi-circ. Groove, R = 0.015"	2.27	"	48	---	"	"	"	"	0.303"ϕ	Ground Notch
42	"	"	Smooth	1.0	"	74	---	"	"	"	"	0.333"ϕ	<10 Microin.
43	"	"	Semi-circ. Groove, R = 0.015"	2.27	"	45	---	"	"	"	"	0.303"ϕ	Ground Notch
44	"	Refractaloy 26 Grain Size, ASTM 3-5	Smooth	1.0	"	45	---	"	"	"	"	0.333"ϕ	<10 Microin.
45	"	"	Semi-circ. Groove, R = 0.015"	2.27	"	42	---	"	"	"	"	0.303"ϕ	Ground Notch
46	39	S-816 Alloy	Smooth	1.0	No	72	---	$2(10^7)$	-----	Rotating Cant.	1,000±	0.2" ϕ	Polish
47	42	S-816 Alloy	Smooth	1.0	No	72	---	$2x10^7$	-----	Rotating Cant.	-----	0.250"ϕ	-----
48	40	S-816 Alloy (1153)	Smooth	1.0	No	57±	---	$2x10^7$	Special	Axial	3,600	0.250"ϕ	400 Grit
49	"	"	60° V-notch R = 0.022"	2.4	"	27±	---	"	"	"	"	"	10 micro-inch
50	"	"	60° V-notch R = 0.010"	3.4	"	24±	---	"	"	"	"	"	"
51	"	"	Smooth With Steady Stress	1.0	25±	49±	---	"	"	"	"	"	400 Grit

Table V. Heat Resistant Alloys (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
40	---	---	---	---	Bhn 345	Ni-35.4, Co-21.4, Cr-18.5, Mo-2.99, Ti-2.63, Al-0.14, Si-1.13, Mn-0.86, + Fe	1800°F, 20 min.; 1350°F, 44 hrs.
41	---	---	---	---	"	"	"
42	---	---	---	---	310	"	1800°F, 20 min.; 1500°F, 20 hrs., 1350°F, 20 hrs.
43	---	---	---	---	"	"	"
44	---	---	---	---	300	"	2100°F, 60 min.; 1500°F, 20 hrs., 1350°F, 20 hrs.
45	---	---	---	---	"	"	"
46	140	67 0.2%	35	29	---	C-0.40, Mn-0.70, P-0.014, S-0.016, Si-0.51, Ni-20.68, Cr-19.79, Mo-3.46, W-4.46, Co-43.40, Cb-3.80, Fe-2.50	1400°F, 16 hrs., AC.
47	147.3	74.3 0.2%	23 2"	---	Rc 27.6	C-0.397, Cr-19.42, Mn-1.12, Ni-20.82, Si-0.50, Mo-4.10, P-0.012, S-0.018, W-4.03, Co-42.9, Cb-2.86, Ta-1.03, Fe-2.99	2300°F, 1 hr., WQ; Aged 1400°F, 16 hrs., FC.
48	147.0	74.0 0.2%	23	---	Rc 27-28	C-0.397, Mn-1.12, Si-0.50, S-0.018, P-0.012, Cr-19.42, Ni-20.62, Mo-4.1, Co-42.9, Fe-2.99, Cb-2.8, Ta-1.03, W-4.03	2300°F, 1 hr., WC; 1400°F, 16 hrs., FC.
49	"	"	"	---	"	"	"
50	"	"	"	---	"	"	"
51	"	"	"	---	"	"	"

Table V. Heat Resistant Alloys (Continued)

Item	Ref.	Description		Fatigue Properties					Testing Machine			Specimen	
				K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Type	Kind of Test	Speed cpm	Size	Surface Finish
52	40	S-816 Alloy (1153)	Smooth with Steady Stress	1.0	52±	34±	---	2x10^7	Special	Axial	3,600	0.250"ϕ	400 Grit
53	"	"	"	"	96±	24±	---	"	"	"	"	"	"
54	"	"	"	"	26±	53±	---	10^6	"	"	"	"	"
55	"	"	"	"	[illegible]	38±	---	"	"	"	"	"	"
56	"	"	"	"	111±	28±	---	"	"	"	"	"	"
57	"	S-816 Alloy (1153)	Smooth with Steady Stress	3.4	10±	20±	---	2x10^7	Special	Axial	3,600	0.250"ϕ	10 micro-inch
58	"	"	"	"	27±	18±	---	"	"	"	"	"	"
59	"	"	"	"	48±	12±	---	"	"	"	"	"	"
60	"	"	"	"	0	32±	---	10^6	"	"	"	"	400 Grit
61	"	"	"	"	12±	32±	---	"	"	"	"	"	10 micro-inch
62	"	"	"	"	30±	20±	---	"	"	"	"	"	"
63	"	"	"	"	58±	14±	---	"	"	"	"	"	"
64	4	Sandvik Steel.	Smooth	1.0	No	76.0	---	2(10^7)	-----	Rotating Cantil.	1,500±	0.37"-0.38"ϕ	400 Grit
65	"	"	60° V-notch R = 0.0065"	3.9	"	25.0	---	"	-----	"	"	0.375"ϕ	-----
66	"	"	Smooth	1.0	"	92.0	---	"	-----	"	"	0.37"-0.38"ϕ	400 Grit
67	"	"	60° V-notch R = 0.0065"	3.9	"	24.0	---	"	-----	"	"	0.375"ϕ	-----

Table V. Heat Resistant Alloys (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
52	147.0	74.0 0.2%	23	---	Rc 27-28	C-0.397, Mn-1.12, Si-0.50, S-0.018, P-0.012, Cr-19.42, Ni-20.62, Mo-4.1, Co-42.9, Fe-2.99, Cb-2.8, Ta-1.03, W-4.03	2300°F, 1 hr., WC; 1400°F, 16 hrs., FC.
53	"	"	"	---	"	"	"
54	"	"	"	---	"	"	"
55	"	"	"	---	"	"	"
56	"	"	"	---	"	"	"
57	"	"	"	---	"	"	"
58	"	"	"	---	"	"	"
59	"	"	"	---	"	"	"
60	"	"	"	---	"	"	"
61	"	"	"	---	"	"	"
62	"	"	"	---	"	"	"
63	"	"	"	---	"	"	"
64	185.7	116.5	6.1 2"	11	---	C-0.98, Mn-0.26, P-0.028, S-0.014, Si-0.22, Cr-1.02, Mo-0.24, Cu-0.02, Ni-0.01	Normalized 1905°F, AC.
65	"	"	"	"	---	"	"
66	203.7	177	---	21	---	"	1905°F, 15 min., OQ; Tempered 1095°F, 1 hr.
67	"	"	---	"	---	"	"

Table V. Heat Resistant Alloys (Continued)

Item	Ref.	Description		Fatigue Properties					Testing Machine			Specimen	
				K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Type	Kind of Test	Speed cpm	Size	Surface Finish
68	45	347 Stainless Steel. 0.064" Sheet	Smooth	1.0	27.5±	29.5±	---	10^8	Sub-reson.	Axial	180 1800	Plate	None
69	"	"	Edge Notches 0.375" Deep R = 0.3175"	2.0	19.5±	19.5±	---	"	"	"	"	"	"
70	"	"	Edge notches 0.375" deep R = 0.0570"	4.0	14.5±	14.5±	---	"	"	"	"	"	"
71	"	403 Stainless Steel. 0.050" Sheet	Smooth	1.0	50±	50±	---	"	"	"	"	"	"
72	"	"	Edge Notches 0.375" Deep R = 0.3175"	2.0	30±	30±	---	"	"	"	"	"	"
73	"	"	Edge Notches 0.375" Deep R = 0.0570"	4.0	18±	18±	---	"	"	"	"	"	"
74	39	Type 403 Alloy	Smooth	1.0	No	96	---	$2(10^7)$	-----	Rotating Cantil.	1,000±	0.2" ϕ	Polish
75	42	Type 403 Alloy	Smooth	1.0	No	65	---	$2x10^7$	-----	Rotating Cantil.	-----	0.250"ϕ	-----
76	40	Type 403 Stainless	Smooth	1.0	No	62±	---	$2x10^7$	Special	Axial	3,600	0.250"ϕ	400 Grit
77	"	"	"	"	"	66±	---	10^6	"	"	"	"	"
78	"	X-40 (Stellite 31) Alloy, Precision Cast	Smooth	1.0	No	42±	---	$2x10^7$	Special	Axial	3,600	0.250"ϕ	400 Grit
79	"	"	60° V-notch R = 0.022"	2.4	"	22±	---	"	"	"	"	"	10 micro-inch

Table V. Heat Resistant Alloys (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
68	92.0	45.6 0.2%	61	---	---	-----	Annealed.
69	"	"	"	---	---	-----	"
70	"	"	"	---	---	-----	"
71	190.0	153.0 0.2%	8	---	Rc 40-41	-----	"Heat treated to Rockwell C 40 to 41".
72	"	"	"	---	"	-----	"
73	"	"	"	---	"	-----	"
74	152	138	17.5	64	Rc 30-36	C-0.12, Mn-0.37, P-0.016, S-0.022, Si-0.26, Ni-0.44, Cr-12.67, Fe-86.1	1700°F, 15 min., AC; Tempered 970°F to 1020°F, 2 hrs., AC.
75	129	111 0.2%	21 2"	65	Rc 24-26	C-0.110, Cr-12.20, Mn-0.51, Ni-0.06, Si-0.34, Mo-0.05, P-0.018, S-0.010, Al-0.03, Sn-0.0089, Fe-bal.	1750°F, 15 min., OQ; 1050°F, 90 min., AC.
76	141.0	127.0	11	---	Rc 24-26	C-0.12, Mn-0.51, Si-0.34, S-0.010, P-0.018, Cr-12.20, Ni-0.06, Mo-0.05, Co-0.03, Al-0.009, Fe-bal.	1750°F, 15 min., OQ; 1000°F, 1.5 hrs., AC.
77	"	"	"	---	"	"	"
78	123.0	68.0 0.2%	11.8	---	Rc 31-41	C-0.46, Mn-0.76, Si-0.71, S-0.009, P-0.011, Cr-25.88, Ni-10.62, Fe-0.93, W-7.11, Co-bal.	Temper 1350°F, 50 hrs., AC.
79	"	"	"	---	"	"	"

Table V. Heat Resistant Alloys (Continued)

Item	Ref.	Description		Fatigue Properties K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Testing Machine Type	Kind of Test	Speed cpm	Specimen Size	Surface Finish
80	40	X-40(Stellite 31) Alloy, Precision Cast	60° V-notch R = 0.010"	3.4	No	28±	---	$2x10^7$	Special	Axial	3,600	0.250"ϕ	10 Micro-inch
81	"	16-25-6 Timken Alloy	Smooth	1.0	"	54±	---	$2x10^7$	Special	Axial	3,600	0.250"ϕ	400 Grit
82	"	"	60° V-notch R = 0.022"	2.4	"	24±	---	"	"	"	"	"	10 micro-inch
83	"	"	60° V-notch R = 0.010"	3.4	"	19±	---	"	"	"	"	"	"
84	39	TP-2-B	Smooth	1.0	No	65	---	$2(10^7)$	-----	Rotating Cantil.	1,000±	0.2" ϕ	Polish
85	"	TP-2-R	"	"	"	47	---	"	-----	"	"	"	"
86	36	Udimet 500 Alloy	Smooth	1.0	No	75±	---	$2.6x10^7$	-----	Axial	3,600	0.250"ϕ	400 Grit
87	"	"	60° V-notch R = 0.010"	3.4	"	29±	---	"	-----	"	"	"	600 Grit
88	40	6.3% Mo-Waspalloy (A-874)	Smooth	1.0	No	58±	---	$2x10^7$	Special	Axial	3,600	0.250"ϕ	400 Grit
89	"	"	60° V-notch R = 0.022"	2.4	"	30±	---	"	"	"	"	"	10 micro-inch
90	"	"	60° V-notch R = 0.010"	3.4	"	25±	---	"	"	"	"	"	"
91	46	Rene 41.	Room. Temp.	1.0	No	63	---	10^7	Schenck	Axial	----	-----	-----
92	"	"	1200°F Tests.	"	"	51	---	"	"	"	----	-----	-----
93	"	"	1400°F Tests.	"	"	58	---	"	"	"	----	-----	-----

Table V. Heat Resistant Alloys (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard	Chemical Composition	Heat Treatment
80	123.0	68.0 0.2%	11.8	---	Rc 31-41	C-0.46, Mn-0.76, Si-0.71, S-0.009, P-0.011, Cr-25.88, Ni-10.62, Fe-0.93, W-7.11, Co-bal.	Temper 1350°F, 50 hrs., AC.
81	120.0	30.0 0.2%	13	---	Bhn 269-311	C-0.102, Mn-1.92, Si-0.528, S-0.009, P-0.01, Cr-16.45, Ni-27.0, Mo-6.60, N_2-0.133, Fe-bal.	Fleischman hot-cold work: Equalize at 1950°F; Reduce section 18% from 1200°F; Stress relieve 1200°F, 8 hrs.
82	"	"	"	---	"	"	"
83	"	"	"	---	"	"	"
84	120	104.5	4.5	4.8	---	Mo-98, W-2	1750°F, 4 hrs.-hydrogen atmosphere.
85	75.5	---	0	0	---	Mo-100	"
86	84 1650°F	---	14 1650°F	---	---	C-0.08, S-0.008, Al-2.99, Ti-3.03, Mo-4.30, Cr-19.0, Co-19.3, Fe-0.40, Si-0.11, Mn-0.10, Cu-0.10, Mg-0.01, Ni-bal.	1975°F, 4 hrs., AC; 1550°F, 24 hrs.; 1400°F, 16 hrs., AC.
87	"	---	"	---	---	"	"
88	156.0	96.0 0.2%	12	---	Rc 35.0	C-0.136, Mn-0.56, Si-0.31, Cr-19.68, Ni-53.3, Mo-6.32, Co-13.55, Ti-2.59, Al-1.04, Fe-2.5	1975°F, 4 hrs., AC; 1550°F, 24 hrs., AC; 1400°F, 16 hrs., AC.
89	"	"	"	---	"	"	"
90	"	"	"		"	"	"
91	---	---	---	---	---	Nominal. C-0.09, Cr-19.0, Mo-9.75, Co-11.0, Ti-3.15, Al-1.75, Ni-bal.	Solutioned at 1950°F; Aged at 1400°F.
92	---	---	---	---	---	"	"
93	---	---	---	---	---	"	"

Table V. Heat Resistant Alloys (Continued)

Item	Ref.	Description		Fatigue Properties					Testing Machine			Specimen	
				K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Type	Kind of Test	Speed cpm	Size	Surface Finish
94	46	Rene 41.	1400°F Tests.	1.0	No	54	---	10^7	Schenck	Axial	-----	-----	-----
95	"	"	1600°F Tests.	"	"	43	---	"	"	"	-----	-----	-----
96	"	"	Room Temp.	"	69.6	46.4	---	"	"	"	-----	-----	-----
97	"	"	1200°F Tests.	"	64.2	42.8	---	"	"	"	-----	-----	-----
98	"	"	1400°F Tests.	"	35.4	23.6	---	"	"	"	-----	-----	-----
99	"	"	1200°F Tests.	"	55.5	37	---	"	"	"	-----	-----	-----
100	"	"	1600°F Tests.	"	27	18	---	"	"	"	-----	-----	-----
101	"	"	1400°F Tests.	"	61.6	15.4	---	"	"	"	-----	-----	-----
102	"	"	1600°F Tests.	"	28.8	7.2	---	"	"	"	-----	-----	-----

Table V. Heat Resistant Alloys (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
94	---	---	---	---	---	Nominal. C-0.09, Cr-19.0, Mo-9.75, Co-11.0, Ti-3.15, Al-1.75, Ni-bal.	Solutioned at 2150°F; Aged at 1650°F.
95	---	---	---	---	---	"	"
96	---	---	---	---	---	"	Solutioned at 1950°F; Aged at 1400°F.
97	---	---	---	---	---	"	"
98	---	---	---	---	---	"	"
99	---	---	---	---	---	"	Solutioned at 2150°F; Aged at 1650°F.
100	---	---	---	---	---	"	"
101	---	---	---	---	---	"	"
102	---	---	---	---	---	"	"

Table VI. Aluminum Alloy 2014 (14S)

Item	Ref.	Description		Fatigue Properties: K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Testing Machine: Type	Kind of Test	Speed cpm	Specimen: Size	Surface Finish
1	47	Extruded 14S-T.		1.0	No	20.5	---	10^8	R.R. Moore	Rotating Bending	10,000	0.300"ø	---
2	"	"		"	"	20.0	---	"	Krouse	Rev.Cant. Const.Defl.	1,750	0.300" thick	---
3	48	Rolled 14S-T6.	Smooth	1.0	No	23	---	10^7	Axial	Push-Pull	1,800 or 3,600	0.400"ø	10 micro inch
4	"	"	Semi-circ. notch. R = 0.100"	1.6	"	21	---	"	"	"	"	"	---
5	"	"	60° V-notch R = 0.032"	2.4	"	13	---	"	"	"	"	"	---
6	"	"	60° V-notch R = 0.010"	3.4	"	9	---	"	"	"	"	"	---
7	49	2014-T6 Longitudinal	Smooth		"	24	---	$2(10^7)$	Schenck	Axial	-----	0.100"ø	---
8	"	"	60° V-notch R = 0.010"		"	11.5	---	"	"	"	-----	"	---
9	"	2014-T6 Short Transv.	Smooth		"	22	---	"	"	"	-----	"	---
10	"	"	60° V-notch R = 0.010"		"	11.5	---	"	"	"	-----	"	---

Table VI. Aluminum Alloy 2014 (14S) (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
1	75.9	67.9	15.5 (4d)	---	---	Mn-0.8, Cu-4.4, Si-0.8, Mg-0.6	------
2	"	"	"	---	---	"	------
3	71.6	63.5	13.6 (2")	---	RA 51.3	Mn-0.76/0.78, Cu-4.19/4.22, Si-0.81/0.83, Mg-0.40/0.41, Fe-0.50/0.51, Zn-0.00/0.01, Cr-0.00, Ti-0.05	Solution 940°F, Age 320°F, 18 hrs.
4	"	"	"	---	"	"	"
5	"	"	"	---	"	"	"
6	"	"	"	---	"	"	"
7	---	---	---	---	---	------	------
8	---	---	---	---	---	------	------
9	---	---	---	---	---	------	------
10	---	---	---	---	---	------	------

Table VII. Aluminum Alloy 2024 (24S)

Item	Ref.	Description	Fatigue Properties K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Testing Machine Type	Kind of Test	Speed cpm	Specimen Size	Surface Finish
1	50	24S-T Polished.	1.0	No	24±	---	10^7	Sonntag	Rev. Bend.	1,800	0.040" Thick	Polished
2	"	" Anodized	"	"	19±	---	"	"	"	"	"	Anodized
3	"	" Polished, then Corroded	"	"	20±	---	"	"	"	"	"	Polished, then Corroded.
4	"	" Anodized, Painted, Corroded	"	"	18±	---	"	"	"	"	"	Anod.&Paint.&Corroded
5	51	Alclad 24S-T3 Notched. Central drilled hole 1/8"ϕ	2.5	Yes-See Figs. 94,95				Bruegge-man	Axial	1,200	0.032" x 0.8"	---
6	52	Alclad 24S-T3, Smooth.	1.0	No	12	---	10^7	Bruegge-man	"	12 & 1,000	0.032" x 0.5"	---
7	"	Bare 24S-T3, Smooth.	"	" - See Fig. 96				"	"	"	"	---
8	47	Extruded "24S-T".	1.0	No	24.0	---	10^8	R.R. Moore	Rotating Bending	10,600	0.300 ϕ	Polished
9	"	"	"	"	22.5	---	"	Krouse	Reversed Cantil.	1,750	0.300" Thick	"
10	48	Rolled 24S-T4 Smooth.	1.0	No	26	---	10^7	Axial	Push-Pull	1,800 or 3,600	0.400" ϕ	10 micro-inch
11	"	" Semi-circ. notch, R = 0.100"	1.6	"	17	---	"	"	"	"	"	---
12	"	" 60° V-notch, R = 0.032"	2.4	"	12	---	"	"	"	"	"	---
13	"	" 60° V-notch, R = 0.010"	3.4	"	10	---	"	"	"	"	"	---

Table VII. Aluminum Alloy 2024 (24S) (Continued)

Item	Static Properties: UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
1	---	---	---	---	---	Army-Navy Spec. AN-A-12	------
2	---	---	---	---	---	"	------
3	---	---	---	---	---	"	------
4	---	---	---	---	---	"	------
5	67,Smooth 60,Notch	50,Tens. 41,Comp.	---	---	---	Commercial Grade	Solution; Strain Hardening.
6	67.4	50,Tens. 46,Comp.	---	---	---	"	"
7	73.6	56,Tens. 50,Comp.	---	---	---	"	"
8	84.4	65.4 0.2%	19.0 4D	---	---	Mn-0.6, Cu-4.5, Mg-1.5	------
9	"	"	"	---	---	"	------
10	72.8	48.6 0.2%	21.4 2"	---	RA 48.5	Mn-0.63, Cu-4.17/4.25, Mg-1.42/1.49 Si-0.13/0.14, Fe-0.30, Zn-0.07, Cr-0.01/0.02, Ti-0.02	Solution, 915°F.
11	"	"	"	---	"	"	"
12	"	"	"	---	"	"	"
13	"	"	"	---	"	"	"

Table VII. Aluminum Alloy 2024 (24S) (Continued)

Item	Ref.	Description		Fatigue Properties K_t	S_m ksi	Se ksi	St. Dev.	Life, Cycles	Testing Machine Type	Kind of Test	Speed cpm	Specimen Size	Surface Finish
14	9,10, 53, 54	Sheet 24S-T3.		1.0	No	22	---	10^7	Krouse	Axial	1,100 to 1,500	0.09" x 1.5"(?)	---
15	"	"	Semi-circ. Notch, R = 0.760"	1.5	"	16.5	---	"	"	"	"	"	Electro-Polish
16	"	"	Hole, Edge Notch & Fillet	2.0	"	12	---	"	"	"	"	"	"
17	"	"	Edge Notch & Fillet	4.0	"	7.5	---	"	"	"	"	"	"
18	"	"	Semi-circ. Notch, R = 0.031"	5.0	"	6.0	---	"	"	"	"	"	"
19	55	Hot Rolled 24S-T4.	Smooth	1.0	No	22	---	10^7	R.R. Moore	Rotating Bending	10,000	0.335"ø	No. 0 Emery
20	"	"	Semi-circ. Notch, R = 0.062"	1.6	"	18	---	"	"	"	"	0.355"ø	Emery Thread
21	"	"	45° V-notch, R - 0.01"	3.1	"	9	---	"	"	"	"	"	"
22	56	Extruded Bars, 24S-T	Smooth	1.0	No	24.6	---	10^7	Schenck or Amsler	Push-Pull	2,000 8,000	0.295"ø	Buffed
23	"	"	Drilled Hole, 0.118" ø	2.5	"	12.3	---	"	"	"	"	"	"
24	57	24S-T3 0.090" Sheet	Milled Notch, 0.378" Deep, R = 0.0570"	4.0	No	5±	---	10^7	Sub-reson. or Hydr. Jack	Push-Pull	See Text	2" x 17" x 0.09" approx.	---

Table VII. Aluminum Alloy 2024 (24S) (Continued)

Item	Static Properties: UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
14	73	54	18.2 2"	---	---	Commercial Grade.	------
15	"	"	"	---	---	"	------
16	"	"	"	---	---	"	------
17	"	"	"	---	---	"	------
18	"	"	"	---	---	"	------
19	70.5	58.0	17.7 4D	---	RB 76	Mn-0.69, Cu-4.70, Mg-1.54, Si-0.16, Fe-0.27, Zn-0.03, Cr-0.06, Ti-0.03, Ni-0.01	Anneal 660°F, 15 min.; Solution 915°F, 45 min.; Age 250°F, 24 hrs.
20	"	"	"	---	"	"	"
21	"	"	"	---	"	"	"
22	77	55 ±	---	14	---	Mn-0.4, Cu-4.1, Mg-1.0, Si $<$ 0.4, Fe $<$ 0.45, Zn $<$ 0.10, Ti $<$ 0.03	(Not given in the reference)
23	"	"	---	"	---	"	"
24	68	---	---	---	---	(Not Given in the Reference)	T3

Table VIII. Aluminum Alloy 6061 (61S)

Item	Ref.	Description		Fatigue Properties					Testing Machine			Specimen	
				K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Type	Kind of Test	Speed cpm	Size	Surface Finish
1	58	61S-T6 "as received"	Smooth	1.0	No	14.5	---	10^7	Krouse	Const. Defl.	---	Plate	---
2	"	"	"	"	12	12	---	"	"	"	---	"	---
3	"	"	Edge Notches 0.7" deep, R = 0.100"	2.5	No	8.5	---	"	"	"	---	"	---
4	"	"	"	"	6.7	6.7	---	"	"	"	---	"	---
5	45	61S-T6 as received 0.125" sheet	Smooth	1.0	13.5	13.5	---	10^7	Sub-reson.	Axial	180 1,800	Plate	None
6	"	"	Edge Notches 0.375" deep, R = 0.3175"	2	7.5	7.5	---	"	"	"	"	"	"
7	"	"	Edge Notches 0.375" deep, R = 0.0570"	4	4	4	---	"	"	"	"	"	"

Table VIII. Aluminum Alloy 6061 (61S) (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
1	45	40 0.2%	12 2"	---	---	Cu-0.25, Cr-0.25, Si-0.6, Mg-1.0	Precip. Hardened.
2	"	"	"	---	---	"	"
3	"	"	"	---	---	"	"
4	"	"	"	---	---	"	"
5	47	42	17 2"	---	---	------	------
6	"	"	"	---	---	------	------
7	"	"	"	---	---	------	------

Table IX. Aluminum Alloy 7075 (75S)

Item	Ref.	Description	Fatigue Properties K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Testing Machine Type	Kind of Test	Speed cpm	Specimen Size	Surface Finish
1	51	Alclad 75S-T6, Notched, Central Drilled Hole, 1/8"ϕ	2.5	Yes - See Figs. 110,111				Bruegge-man	Axial	1,200	0.032" x 0.8"	-----
2	47	Extruded 75S-T	1.0	No	22	---	10^8	R.R. Moore	Rotating Bending	10,600	0.300"ϕ	-----
3	"	"	"	"	20	---	"	Krouse	Cant. Const. Defl.	1,750	0.300" Thick	-----
4	"	Plate 75S-T6. Longitudinal Specimens	"	"	29	---	"	"	"	"	1/4"	10 micro-inch
5	"	" "	"	"	25	---	"	R.R. Moore	Rotating Bending	3,450 & 10,000	"	"
6	"	" "	"	"	21	---	"	Krouse	Cant. Const. Defl.	1,750	1/4" x 1/4"	20 micro-inch
7	"	" "	"	"	19	---	"	"	"	"	1/4" Thick	"
8	"	" "	"	"	19	---	"	"	"	"	1/4"x3/4"	"
9	"	" "	"	"	18	---	"	"	"	"	1/8"x1/4"	"
10	"	Plate 75S-T6. Transverse Specimens	"	"	21	---	"	"	"	"	1/4"	10 micro-inch
11	"	" "	"	"	22	---	"	R.R. Moore	Rotating Bending	3,450 & 10,000	1/4"	"
12	"	" "	"	"	20	---	"	Krouse	Cant. Const. Defl.	1,750	1/4"x1/4"	20 micro-inch
13	"	" "	"	"	20	---	"	"	"	"	1/4" Thick	"

Table IX. Aluminum Alloy 7075 (75S) (Continued)

Item	Static Properties: UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
1	78, Smooth 77, Notch	71, Tens. 66, Comp.	---	---	---	Commercial Grade Alclad 75S-T6	------
2	87.6	77.7 0.2%	14.0 4D	---	---	Mn-0.2, Cr-0.3, Cu-1.6, Mg-2.5, Zn-5.6	Not Given.
3	"	"	"	---	---	"	"
4	84.4	77.4 0.2%	11.0 4D	---	---	Mn-0.30/0.10, Cr-0.40/0.15, Cu-2.0/1.2, Mg-2.9/2.1, Zn-6.1/5.1, Ti-0.20, Si-0.5, Fe-0.7	Solution 916°F to 920°F; Age 210°F, 6 hrs.; Reheat to 10 hrs. 315°F; AC.
5	"	"	"	---	---	"	"
6	84.2	77.0	11.7 2"	---	---	"	"
7	"	"	"	---	---	"	"
8	"	"	"	---	---	"	"
9	"	"	"	---	---	"	"
10	82.4	72.9	11.0	---	---	"	"
11	"	"	"	---	---	"	"
12	82.2	72.3	11.7	---	---	"	"
13	"	"	"	---	---	"	"

Table IX. Aluminum Alloy 7075 (75S) (Continued)

Item	Ref.	Description	Fatigue Properties K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Testing Machine Type	Kind of Test	Speed cpm	Specimen Size	Surface Finish
14	53	Sheet, Smooth	1.0	No	30	---	10^7	Krouse	Axial	1,100 to 1,500	0.090" x 1.15"	-----
15	10	Semi-circ. notch, R = 0.760"	1.5	No	17	---	10^7	Krouse	Axial	1,100 to 1,500	0.090" x 1.5	Electro-Polish
16	9	Hole, Edge notch, fillet.	2.0	"	15.5	---	"	"	"	"	"	"
17	"	Edge notch, fillet.	4.0	"	7.5	---	"	"	"	"	"	"
18	10	Semi-circ. notch, R = 0.031".	5.0	"	6.0	---	"	"	"	"	"	"
19	55	Hot rolled 75S-T6. Smooth.	1.0	No	25	---	10^7	R.R. Moore	Rotating Bending	10,000	0.335"ϕ	No. 0 Emery
20	"	" Semi-circ. notch, R = 0.062".	1.6	"	18	---	"	"	"	"	"	Emery Thread
21	"	" 45° V-notch R = 0.01".	3.1	"	12.5	---	"	"	"	"	"	"
22	59	Rolled & Drawn Rod 75S-T6 Smooth.	1.0	No	29	---	10^7	R.R. Moore	Rotating Bending	3,500 10,000	0.300"ϕ	3/0
23	"	" 60° V-notch R = 0.0002"		"	12	---	"	"	"	"	0.330"ϕ	-----
24	"	Extruded Bar 75S-T6 Smooth.	1.0	"	26	---	"	"	"	"	0.300"ϕ	3/0
25	23	75S-T Smooth.	1.0	No	32	---	10^7	Rot. Cant.	Beam	10,000	0.15"ϕ	2/0

Table IX. Aluminum Alloy 7075 (75S) (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
14	82.5	76 0.2%	11.4 2"	---	---	Commercial 75S-T6 Sheet.	------
15	"	"	"	---	---	"	------
16	"	"	"	---	---	"	------
17	"	"	"	---	---	"	------
18	"	"	"	---	---	"	------
19	84	77	15 4D	---	RB 88	Mn-0.01, Cr-0.23, Cu-1.62, Mg-2.50, Zn-5.44, Ti-0.02, Si-0.11, Fe-0.17, Be-0.001	780°F, 15 min., AC; 450°F, 30 min.; 915°F, 45 min.; Age 250°F, 24 hrs.
20	"	"	"	---	"	"	"
21	"	"	"	---	"	"	"
22	---	---	---	---	---	Cr-0.03, Cu-1.6, Mg-2.5, Zn-5.6	T6
23	---	---	---	---	---	"	"
24	---	---	---	---	---	"	"
25	83.7	73.1 0.2%	16 2"	31.6	Bhn 178.5	Mn-0.3, Cr-0.15/0.40, Cu-1.2/2.0, Mg-2.1/2.4, Zn-5.1/6.5, Ti-0.2, Si-0.5, Fe-0.7	Tested as received.

Table IX. Aluminum Alloy 7075 (75S) (Continued)

Item	Ref.	Description		Fatigue Properties K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Testing Machine Type	Kind of Test	Speed cpm	Specimen Size	Surface Finish
26	60	7/8" Bar Stock	Smooth.	1.0	No	See Text			Rot. Cant.	Beam	8,000	0.15" ϕ	2/0
27	57	0.090" Sheet	Milled Notches 0.0375" Deep. R = 0.0570".	4.0	No	See Text			Sub-res. or Hyd. Jack	Axial	See Text	2.25" x 16.89" x 0.090"	
28	49	7075S-T6 Hand Forged	Longitudinal	1.0	No	25	---	$2x10^7$	Schenck	Axial	----	0.100"ϕ	-----
29	"	"	"	2.4	"	11	---	"	"	"	----	"	-----
30	"	"	Short Transverse	1.0	"	20	---	"	"	"	----	"	-----
31	"	"	"	2.4	"	11	---	"	"	"	----	"	-----

Table IX. Aluminum Alloy 7075 (75S) (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
26	83.7	73.1 0.2%	16 2"	31.6	RB 91.2	------	------
27	86	---	---	---	---	------	------
28	---	---	---	---	---	------	------
29	---	---	---	---	---	------	------
30	---	---	---	---	---	------	------
31	---	---	---	---	---	------	------

Table X. Aluminum Alloy 7076 (76S)

Item	Ref.	Description	Fatigue Properties K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Testing Machine Type	Kind of Test	Speed cpm	Specimen Size	Surface Finish
1	61	Bending	1.0	No	24.5	---	10^8	Krouse	Const. Defl.	----	0.26" ϕ	3/0 Emery
2	"	"	"	12	23	---	"	"	"	----	"	"
3	"	"	"	30	21	---	"	"	"	----	"	"
4	"	"	"	45	20	---	"	"	"	----	"	"
5	"	"	"	60	19	---	"	"	"	----	"	"
6	"	Torsion (Ult. Str., Shear, 60 ± ksi)	"	No	16 Tors.	---	"	"	"	----	"	"
7	"	" "	"	12 Tors.	14.5 Tors.	---	"	"	"	----	"	"
8	"	" "	"	30 Tors.	12 Tors.	---	"	"	"	----	"	"
9	"	" "	"	45 Tors.	8 Tors.	---	"	"	"	----	"	"
10	62	----------	1.0	No	22	---	10^8	Krouse Cantil.	Rotating Bending	6,000	0.26" ϕ	2/00 Emery
11	"	----------	"	"	22.2	---	"	Special	"	13,000	0.14" ϕ	"
12	"	----------	"	"	24	---	"	Krouse Vib.	Cantil. Bending	1,750	0.26" ϕ	"
13	"	----------	"	"	18.5	---	"	"	"	"	0.25" x 0.25"	"
14	"	----------	"	"	16.5	---	"	"	"	"	1/4" x 3/4"	"

Table X. Aluminum Alloy 7076 (76S) (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
1	73	67 0.2%	---	---	---	Cu-0.6, Zn-7.6, Mg-1.6, Mn-0.5, Ti-0.1, Fe-0.5, Si-0.25	Solution 860°F, 10 hrs., WQ; Age 275°F, 12 hrs.
2	"	"	---	---	---	"	"
3	"	"	---	---	---	"	"
4	"	"	---	---	---	"	"
5	"	"	---	---	---	"	"
6	"	"	---	---	---	"	"
7	"	"	---	---	---	"	"
8	"	"	---	---	---	"	"
9	"	"	---	---	---	"	"
10	73	67 0.2%	19.2 2"	40.6	Bhn 146	"	"
11	"	"	"	"	"	"	"
12	"	"	"	"	"	"	"
13	"	"	"	"	"	"	"
14	"	"	"	"	"	"	"

Table X. Aluminum Alloy 7076 (76S) (Continued)

Item	Ref.	Description	Fatigue Properties					Testing Machine			Specimen	
			K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Type	Kind of Test	Speed cpm	Size	Surface Finish
15	62	60° V-notch, R = 0.01".	2.6	No	8.8	---	10^8	Krouse Cantil.	Rotating Bending	6,000	0.30" ϕ	-----
16	"	"	3.6	"	7.5	---	"	Krouse Vib.	Cantil. Bending	1,750	0.300" x 3/4"	-----
17	"	"	"	-8.5	8.5	---	"	"	"	"	"	-----
18	"	"	"	-4.0	8.0	---	"	"	"	"	"	-----
19	"	"	"	6.5	6.5	---	"	"	"	"	"	-----
20	"	"	"	10.75	5.75	---	"	"	"	"	"	-----
21	"	"	"	14.5	4.5	---	"	"	"	"	"	-----
22	29	7/8" ϕ Bars.	1.0	No	27	1.6	$5(10^8)$	R.R. Moore	Rotating Bending	12,000	0.230"ϕ	2-3 micro-inch
23	"	"	"	"	31.5	1.3±	Prot	"	"	"	"	"

Table X. Aluminum Alloy 7076 (76S) (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
15	73	67 0.2%	19.2 2"	40.6	Bhn 146	Cu-0.6, Zn-7.6, Mg-1.6, Mn-0.5, Ti-0.1, Fe-0.5, Si-0.25	Solution 860°F, 10 hrs., WQ; Age 275°F, 12 hrs.
16	"	"	"	"	"	"	"
17	"	"	"	"	"	"	"
18	"	"	"	"	"	"	"
19	"	"	"	"	"	"	"
20	"	"	"	"	"	"	"
21	"	"	"	"	"	"	"
22	76	68 0.2%	16 ± 4D	30 ±	Rb 69	Cu-0.63, Mn-0.48, Fe-0.45, Si-0.20, Mg-1.47, Zn-7.18	Heat treated by vendor.
23	"	"	"	"	"	"	"

Table XI. Aluminum Alloy 7079

Item	Ref.	Description		Fatigue Properties K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Testing Machine Type	Kind of Test	Speed cpm	Specimen Size	Surface Finish
1	49	Hand Forged.	Longitudinal	1.0	No	24	---	2×10^7	Schenck	Axial	----	0.100"ϕ	-----
2	"	"	"	2.4	"	11	---	"	"	"	----	"	-----
3	"	"	Short Transverse	1.0	"	21	---	"	"	"	----	"	-----
4	"	"	"	2.4	"	11	---	"	"	"	----	"	-----

Table XI. Aluminum Alloy 7079 (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
1	---	---	---	---	---	Nominal. Si-0.30, Fe-0.40, Cu-0.40/0.8, Mn-0.10/0.30, Mg-2.9/3.7, Cr-0.10/0.25, Zn-3.8/4.8, Ti-0.10, Other-0.15.	------
2	---	---	---	---	---	"	------
3	---	---	---	---	---	"	------
4	---	---	---	---	---	"	------

Table XII. Magnesium Alloys

Item	Ref.	Description		Fatigue Properties K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Testing Machine Type	Kind of Test	Speed cpm	Specimen Size	Surface Finish
1	63	AZ31X.	Not coated.	1.0	No	13.2	---	10^7	Krouse	Const. Defl. Cantil.	----	1/2" x 0.25"	-----
2	"	"	Anodic HAE coating. 0.0025" thick.	"	"	9.7	---	"	"	"	----	"	-----
3	"	"	Not coated.	?	"	10.0	---	"	"	"	----	1 1/4" x 0.25" 1/4" hole	-----
4	"	"	Anodic HAE coating. 0.0025" thick.	"	"	7.7	---	"	"	"	----	"	-----
5	"	"	Not coated.	"	"	12.7	---	"	"	"	----	0.094" Thick 1/4" hole	-----
6	"	"	Anodic HAE coating. 0.0025" thick.	"	"	9.4	---	"	"	"	----	"	-----
7	"	"	Not coated.	1.0	No	12.5	---	"	"	"	----	0.094" Thick No Hole	-----
8	"	"	Anodic HAE coating. 0.0015" thick.	"	"	11.6	---	"	"	"	----	"	-----
9	"	"	Not coated.	"	"	11.5	---	"	"	"	----	0.04" Thick No Hole	-----
10	"	"	Anodic HAE coating. 0.0015" thick.	"	"	10.7	---	"	"	"	----	"	-----
11	"	"	Not coated.	"	4.75	4.75	---	"	"	"	----	"	-----
12	"	"	Anodic HAE coating. 0.0015" thick.	"	"	"	---	"	"	"	----	"	-----

Table XII. Magnesium Alloys (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
1	---	---	---	---	---	Al-3.0, Zn-1.0, Mn-0.3	------
2	---	---	---	---	---	"	------
3	---	---	---	---	---	"	------
4	---	---	---	---	---	"	------
5	---	---	---	---	---	"	------
6	---	---	---	---	---	"	------
7	---	---	---	---	---	"	------
8	---	---	---	---	---	"	------
9	---	---	---	---	---	"	------
10	---	---	---	---	---	"	------
11	---	---	---	---	---	"	------
12	---	---	---	---	---	"	------

Table XII. Magnesium Alloys (Continued)

Item	Ref.		Description	Fatigue Properties					Testing Machine			Specimen	
				Kt	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Type	Kind of Test	Speed cpm	Size	Surface Finish
13	64	FS-1h (AZ31X)	Smooth	1.0	7.8	7.8	---	10^7	Krouse	Cant. Bend.	----	0.064" Thick	-----
14	"	"	60° V-notch, 0.003" deep, R = 0.001".	2.0	7.5	7.5	---	"	"	"	----	"	-----
15	"	"	Smooth	1.0	14.4	8.6	---	"	"	Axial	----	"	-----
16	"	"	Smooth	1.0	19.5	6.5	---	"	"	"	----	"	-----
17	"	"	60° V-notch, 0.003" deep, R = 0.001".	2.0	10.9	6.6	---	"	"	"	----	"	-----
18	"	"	Smooth	1.0	9.8	9.8	---	"	"	Cant. Bend.	----	0.020" Thick	-----
19	"	"	Edge Notches, R = 0.125"	1.6	6.5	6.5	---	"	"	"	----	"	-----
20	"	FS-1a Sheet	Smooth	1.0	6.8	6.8	---	"	"	"	----	0.064" Thick	-----
21	"	"	60° V-notch, 0.003" deep, R = 0.001"	2.0	6.5	6.5	---	"	"	"	----	"	-----
22	"	"	Smooth	1.0	13.1	7.9	---	"	"	Axial	----	"	-----
23	"	"	Smooth	"	19.5	6.5	---	"	"	"	----	"	-----
24	"	"	60° V-notch, 0.003" deep, R = 0.001".	2.0	10.6	6.4	---	"	"	"	----	"	-----
25	"	"	Smooth	1.0	7.8	7.8	---	"	"	Cant. Bend.	----	0.020" Thick	-----
26	"	"	Edge Notches, R = 0.125".	1.6	6.5	6.5	---	"	"	"	----	"	-----

Table XII. Magnesium Alloys (Continued)

Item	Static Properties					Chemical Composition	Heat Treatment
	UTS ksi	YP ksi	Elong. %	R.A. %	Hard.		
13	33	35± 0.2%	8 ± 2"	---	---	Al-3.0, Mn-0.3, Zn-1.0 (nominal)	------
14	"	"	"	---	---	"	------
15	"	"	"	---	---	"	------
16	"	"	"	---	---	"	------
17	"	"	"	---	---	"	------
18	"	"	"	---	---	"	------
19	"	"	"	---	---	"	------
20	37	22	21	---	---	"	------
21	"	"	"	---	---	"	------
22	"	"	"	---	---	"	------
23	"	"	"	---	---	"	------
24	"	"	"	---	---	"	------
25	"	"	"	---	---	"	------
26	"	"	"	---	---	"	------

Table XII. Magnesium Alloys (Continued)

Item	Ref.	Description			Fatigue Properties					Testing Machine			Specimen	
					K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Type	Kind of Test	Speed cpm	Size	Surface Finish
27	64	FS-1 Sheet Extrusion	Grain Size, 0.003"-0.008"	Smooth	1.0	5.0	5.0	---	10^7	Krouse	Cant. Bend.	----	0.117" Thick	-----
28	"	"	"	"	"	No	21.0	---	"	R.R. Moore	Rotating Bending	----	0.300"ϕ	3/0 and Buffed
29	"	"	"	Semi-circ. Notch, R = 0.030"	2.0	"	10.5	---	"	"	"	----	0.295"ϕ	-----
30	"	C-HT	Sand Casting.	Smooth	1.0	"	16.5	---	"	"	"	----	0.250"ϕ	-----
31	"	C-HTA	"	"	"	"	16.0	---	"	"	"	----	"	-----
32	"	C-HTS	"	"	"	"	15.0	---	"	"	"	----	"	-----
33	"	C-AC	"	"	"	"	14.5	---	"	"	"	----	"	-----
34	"	C-HT	"	Semi-circ. Notch, R = 0.030"	2.0	"	13.5	---	"	"	"	----	0.295"ϕ	-----
35	"	C-HTS	"	"	"	"	10.0	---	"	"	"	----	"	-----
36	"	C-HTA	"	"	"	"	9.5	---	"	"	"	----	"	-----
37	"	C-AC	"	"	"	"	8.5	---	"	"	"	----	"	-----
38	"	C-HTS	"	60° V-notch 0.09" deep, R = 0.002"	5.0	"	6.5	---	"	"	"	----	0.300"ϕ	-----
39	"	C-HT	"	"	"	"	6.0	---	"	"	"	----	"	-----
40	"	C-HTA	"	"	"	"	5.0	---	"	"	"	----	"	-----
41	"	C-AC	"	"	"	"	5.0	---	"	"	"	----	"	-----

Table XII. Magnesium Alloys (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
27	40	30	15	---	---	Al-3.0, Mn-0.3, Zn-1.0 (Nominal)	------
28	"	"	"	---	---	"	------
29	"	"	"	---	---	"	------
30	"	16	10	---	---	Al-9.0, Mn-0.1, Zn-2.0	------
31	"	23	2	---	---	"	------
32	"	20	3	---	---	"	------
33	24	14	2	---	---	"	------
34	40	16	10	---	---	"	------
35	"	20	3	---	---	"	------
36	"	23	2	---	---	"	------
37	24	14	2	---	---	"	------
38	40	20	3	---	---	"	------
39	"	16	10	---	---	"	------
40	"	23	2	---	---	"	------
41	24	14	2	---	---	"	------

Table XII. Magnesium Alloys (Continued)

Item	Ref.	Description	Fatigue Properties					Testing Machine			Specimen	
			K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Type	Kind of Test	Speed cpm	Size	Surface Finish
42	64	C-HTA Perm. Mold Casting. Smooth	1.0	No	16.0	---	10^7	R.R. Moore	Rotating Bending	----	0.250"ϕ	-----
43	"	" Semi-circ. Notch, R = 0.030"	2.0	"	10.5	---	"	"	"	----	0.295"ϕ	-----
44	65	1 FS-1h, Hard Rolled Sheet. R' = 0.75	1.0	11.2	10.8	---	10^7	Krouse	Axial	1,500	1.000" x 0.064"	-----
45	"	" R' = 0.60	"	14.5	8.5	---	"	"	"	"	"	-----
46	"	" R' = 0.50	"	21	7	---	"	"	"	"	"	-----
47	"	" R' = 0.25	"	25.5	6.5	---	"	"	"	"	"	-----
48	"	" R' = 0.02	"	37	5	---	"	"	"	"	"	-----
49	66	ZK60A-T5. Smooth	1.0	No	22	---	10^7	Axial	Push-Pull	3,600	0.400"ϕ	10 micro-in.
50	"	" 60° V-notch, R = 0.032"	2.4	"	10	---	"	"	"	"	0.400" Root	-----
51	"	" 60° V-notch, R = 0.010"	3.4	"	7.5	---	"	"	"	"	"	-----
52	4	J-1. Smooth	1.0	No	18.0	---	$2(10^7)$	-----	Rotating Cant.	1,500±	0.6" ±	900 Grit
53	"	" 60° V-notch, R = 0.010"	3.9	"	5.5	---	"	-----	"	"	0.584"	-----
54	67	FS-1A (AZ-31A-0) Mg. Alloy. Axial Loading	1.0	No	12.0	---	10^7	Krouse	Axial	1,500-1,100	0.172" Thick	600 Grit

Table XII. Magnesium Alloys (Continued)

Item	Static Properties					Chemical Composition	Heat Treatment
	UTS ksi	YP ksi	Elong. %	R.A. %	Hard.		
42	---	---	---	---	---	Al-9.0, Mn-0.1, Zn-2.0	------
43	---	---	---	---	---	"	------
44	45±	35±	8± 2"	---	---	Al-2.8, Mn-0.3, Zn-1.0 (nominal)	------
45	"	"	"	---	---	"	------
46	"	"	"	---	---	"	------
47	"	"	"	---	---	"	------
48	"	"	"	---	---	"	------
49	47.5	40.9 0.2%	21.4 2"	---	---	Zn-5.6, Zr-0.66, + impurities	Extruded at 625-680°F, 5-7 ft. p. min. Aged 24 hrs. at 300°F.
50	"	"	"	---	---	"	"
51	"	"	"	---	---	"	"
52	46.0	33.5 0.2%	14.5	---	---	Al-7.2/5.8, An-0.4/1.5, Si-0.3 max., Mn-0.15 min., Cu-0.05 max., Fe-0.005 max.	(Extruded bars, need "as is")
53	"	"	"	---	---	"	"
54	36.8	22.4	3.4	44.5	DPH 58 2.5 kg	As specified by ASM.	Stress Relieved 500°F, 15 min., AC.

Table XII. Magnesium Alloys (Continued)

Item	Ref.	Description		Fatigue Properties K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Testing Machine Type	Kind of Test	Speed cpm	Specimen Size	Surface Finish
55	67	FS-1a (AZ-31A-O) Mg. Alloy	Plate Bending	1.0	No	12.0	---	10^7	Krouse	Plate Bending	1,725	0.235" Thick	600 Grit
56	"	J-1 (AZ61A-F) Mg. Alloy	Plate Bending	"	"	10.0	---	"	"	"	"	"	"
57	"	"	Axial Loading	"	"	14.0	---	"	"	Axial	1,500-1,100	0.172" Thick	"
58	"	"	Rotating Bending	"	"	20.0	---	"	R.R. Moore	Rotating Bending	Up to 10,000	0.300"ϕ	"
59	"	O-1 (AZ80A-F) Mg. Alloy	Plate Bending	"	"	10.0	---	"	Krouse	Plate Bending	1,725	0.235" Thick	"
60	"	"	Axial Loading	"	"	12.0	---	"	"	Axial	1,500-1,100	0.172" Thick	"
61	"	"	Rotating Bending	"	"	22.0	---	"	R.R. Moore	Rotating Bending	Up to 10,000	0.300"ϕ	"
62	68	AZ81-T4. Cast Magnesium Alloy	Smooth	1.0	No	9.5	---	$2x10^8$	Rotating Beam	Bending	----	----	Machine
63	"	"	Notched	2.6	"	7.5	---	"	"	"	----	----	"
64	69	HM-31 (Thorium-Manganese) Forged Mg. Alloy	Room Temperature	1.0	13.2	13.2	---	10^8	Axial	-----	----	----	-----
65	"	"	500°F Tests	"	5.5 500°F	5.5 500°F	---	"	"	-----	----	----	-----
66	"	"	650°F Tests	"	4.2 650°F	4.2 650°F	---	"	"	-----	----	----	-----

Table XII. Magnesium Alloys (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
55	36.8	22.4	3.4	44.5	DPH 58 2.5 kg	As specified by ASM.	Stress Relieved 500°F, 15 min., AC.
56	44.9	28.6	20.0	17.7	---	"	750°F, 2 hrs., AC; Stress Relieved 600°F, 15 min., AC.
57	"	"	"	"	---	"	"
58	"	"	"	"	---	"	"
59	48.4	31.2	18.1	18.3	---	"	"
60	"	"	"	"	---	"	"
61	"	"	"	"	---	"	"
62	34	10	7 2"	---	---	------	------
63	"	"	---	---	---	------	------
64	46.9	41.7	16.2	---	---	------	------
65	20.0 500°F	20.3 500°F	25.7 500°F	---	---	------	------
66	---	---	---	---	---	------	------

Table XII. Magnesium Alloys (Continued)

Item	Ref.	Description		Fatigue Properties					Testing Machine			Specimen	
				K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Type	Kind of Test	Speed cpm	Size	Surface Finish
67	69	HK-31 (Thorium-Zirconium) Annealed Mg. Alloy	Room Temperature	1.0	8.5	8.5	---	10^8	Axial	-----	----	----	-----
68	"	"	500°F Tests	"	3.5	3.5	---	"	"	-----	----	----	-----
69	"	"	600°F Tests	"	2.5	2.5	---	"	"	-----	----	----	-----
70	70	HM-21 (Thorium-Manganese) Forged Mg. Alloy	Room Temperature	1.0	10.2	10.2	---	10^7	Axial	-----	----	----	-----
71	"	"	500°F Tests	"	6.2 500°F	6.2 500°F	---	"	"	-----	----	----	-----
72	"	"	"	"	No	7.0 500°F	---	"	"	-----	----	----	-----
73	"	"	650°F Tests	"	4.5 650°F	4.5 650°F	---	"	"	-----	----	----	-----
74	"	"	"	"	No	6.0 650°F	---	"	"	-----	----	----	-----

Table XII. Magnesium Alloys (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
67	31.0	21.0	21.0	---	---	------	------
68	16.0 500°F	14.0 500°F	18.0 500°F	---	---	------	------
69	---	---	---	---	---	------	------
70	---	---	---	---	---	------	------
71	---	---	---	---	---	------	------
72	---	---	---	---	---	------	------
73	---	---	---	---	---	------	------
74	---	---	---	---	---	------	------

Table XIII. Titanium Alloys

Item	Ref.	Description		Fatigue Properties K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Testing Machine Type	Kind of Test	Speed cpm	Specimen Size	Surface Finish
1	71	Rc55 Type Ti-Alloy.	Smooth	1.0	No	55	---	10^7	-----	Rotating Bending	1,800	0.275"ϕ	-----
2	"	"	60° V-notch, R = 0.010"	1.78	"	37	---	"	-----	"	"	0.225"ϕ root	-----
3	"	"	Semi-circ. notch, R = 0.025"	2.50	"	30	---	"	-----	"	"	"	-----
4	"	"	60° V-notch, R = 0.005"	3.48	"	25	---	"	-----	"	"	"	-----
5	"	"	Smooth	1.0	"	43.6	---	"	-----	"	10,000	0.275"ϕ	-----
6	"	"	Semi-circ. notch, R = 0.025"	2.50	"	38	---	"	-----	"	"	0.225"ϕ root	-----
7	72	Ti-150A	Smooth	1.0	No	63 to 70	---	$2x10^7$	-----	Rotating Bending	-----	0.300"ϕ	Ground
8	"	"	60° V-notch, R - 0.010"	2.7	"	21	---	"	-----	"	-----	"	"
9	"	"	Smooth	1.0	"	68	---	"	-----	"	-----	"	Mach. & Polish
10	"	"	60° V-notch, R = 0.010"	2.7	"	40	---	"	-----	"	-----	"	"
11	"	"	Smooth	1.0	"	54	---	"	-----	"	-----	"	Stretch & Ground
12	"	"	"	1.0	"	56	---	"	-----	"	-----	"	Ground & Sealed
13	"	RC-130B	Smooth	1.0	"	67	---	"	-----	"	-----	"	Ground

Table XIII. Titanium Alloys (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
1	---	Prop. Lim. 60±	---	---	RC 20-24	C-0.156, N-0.040	------
2	---	"	---	---	"	"	------
3	---	"	---	---	"	"	------
4	---	"	---	---	"	"	------
5	---	"	---	---	RC 17-20	C-0.188, N-0.045	------
6	---	"	---	---	"	"	------
7	137.3 to 155	122 to 140.8	19.5 to 24.5	---	---	Cr-2.6, Fe-1.3, O_2-0.2	------
8	"	"	"	---	---	"	------
9	"	"	"	---	---	"	------
10	"	"	"	---	---	"	------
11	"	"	"	---	---	"	------
12	"	"	"	---	---	"	------
13	151.5 to 159.2	140.9 to 154.4	11 to 15	---	---	Mn-4.0, Al-4.0	Anneal 1300°F, AC.

Table XIII. Titanium Alloys (Continued)

Item	Ref.	Description	Fatigue Properties K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Testing Machine Type	Kind of Test	Speed cpm	Specimen Size	Surface Finish
14	72	RC-130B 60° V-notch R = 0.010"	2.7	No	24	---	2x10[7]	-----	Rotating Bending	-----	0.300"ϕ	Ground
15	73	Rc-130B Smooth "Superground Finish"	1.0	No	102	3.5±	10[7]	R.R. Moore	Rotating Bending	10,000	0.3000"ϕ 0.2500"ϕ	Super
16	74	Ti-75A Smooth	1.0	No	43±	---	10[7]	R.R. Moore	Rotating Bending	1,800	0.250"ϕ	8-12 micro-in.
17	"	" "	"	"	44±	---	"	"	"	"	"	"
18	"	" "	"	"	42±	---	"	"	"	10,000	"	"
19	75	Ti-75A Rolled 60° V-notch R = 0.010"	3.0	No	50±	---	10[7]	R.R. Moore	Rotating Bending	6,000	0.250"ϕ	-----
20	"	" Machined Radius Notch R = 3/32"	1.4	"	45±	---	"	"	"	"	0.300"ϕ	-----
21	"	" Machined Square Notch Fillet R = 0.010"	2.8	"	18±	---	"	"	"	"	"	-----
22	"	" Machined 60° V-notch, R = 0.010"	3.2	"	18±	---	"	"	"	"	"	-----
23	"	" Diamond Ground 60° V-notch, R = 0.010"	"	"	17±	---	"	"	"	"	"	-----
24	74	RC-130B Smooth	1.0	No	89±	---	10[7]	R.R. Moore	Rotating Bending	6,000	0.250"ϕ	5-9 micro-in.
25	"	" "	"	"	91±	---	"	"	"	"	"	"
26	"	" "	"	"	91±	---	"	"	"	"	"	"

Table XIII. Titanium Alloys (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
14	151.5 to 159.2	140.9 to 154.4	11 to 15	---	---	Mn-4.0, Al-4.0	Anneal 1300°F, AC.
15	163.3	153.9	13.9	---	---	------	------
16	90.5	Prop. Lim. 45.0	25.5 2"	50.9	---	C-0.025, N-0.061, Fe-0.19	Annealed 1450°F in Argon.
17	84.3	P.L. 47.9	27.3 2"	42	---	C-0.04/0.07, N-0.10, Fe-0.20, W-0.01, H-0.02/0.05, O-0.20	"
18	"	"	"	"	---	"	"
19	"	"	"	"	---	"	"
20	"	"	"	"	---	"	"
21	"	"	"	"	---	"	"
22	"	"	"	"	---	"	"
23	"	"	"	"	---	"	"
24	157.7	P.L. 124.8	17.0 2"	44.7	---	C-0.1, N-0.03, Mn-5.9, Al-5.0	Annealed 1450°F in Argon.
25	149.2	P.L. 82.2	15.0 2"	43.1	---	C-0.1, N-0.02, Mn-4.4, Al-4.1	"
26	160.0	119.0	18.0 2"	47.0	---	C-0.1, N-0.08, Mn-3.9, Al-3.9	"

Table XIII. Titanium Alloys (Continued)

Item	Ref.		Description	Fatigue Properties					Testing Machine			Specimen	
				K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Type	Kind of Test	Speed cpm	Size	Surface Finish
27	75	RC-130B	Machined Radius Notch R = 3/32"	1.4	No	60±	---	10^7	R.R. Moore	Rotating Bending	6,000	0.300"ϕ	-----
28	"	"	Machined Square Notch Fillet R = 0.010"	2.8	"	53±	---	"	"	"	"	"	-----
29	"	"	Machined 60° V-notch R = 0.010"	3.2	"	38±	---	"	"	"	"	"	-----
30	"	"	Rolled 60° V-notch R = 0.010"	3.0	"	87±	---	"	"	"	"	0.250"ϕ	-----
31	"	"	Very Heavily Rolled V-notch, R = 0.010"	2.4	"	86±	---	"	"	"	"	0.150"ϕ	-----
32	"	"	Machined 60° V-notch R = 0.010"	3.2	"	37±	---	"	"	"	"	0.300"ϕ	-----
33	"	"	Commercially Ground Square Notch. Fillet R = 0.010"	2.5	"	20±	---	"	"	"	"	0.250"ϕ	-----
34	"	"	Comercially Ground 60° V-notch, R = 0.010"	3.0	"	13±	---	"	"	"	"	"	-----
35	74	RC-A-30314	Smooth	1.0	No	68±	---	10^7	R.R. Moore	Rotating Bending	6,000	0.250"ϕ	-----
36	75	RC-A-30314	Rolled 60° V-notch R = 0.010"	3.0	No	98±	---	10^7	R.R. Moore	Rotating Bending	6,000	0.250"ϕ	-----
37	"	"	Machined Square Notch Fillet R = 0.010"	2.8	"	42±	---	"	"	"	"	0.300"ϕ	-----
38	"	"	Machined 60° V-notch R = 0.010"	3.2	"	27±	---	"	"	"	"	"	-----
39	"	"	Diamond Ground 60° V-notch, R = 0.010"	3.2	"	20±	---	"	"	"	"	"	-----

Table XIII. Titanium Alloys (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
27	160.0	119.0	18.0 2"	47.0	---	C-0.1, N-0.08, Mn-3.9, Al-3.9	Annealed 1450°F in Argon.
28	"	"	"	"	---	"	"
29	"	"	"	"	---	"	"
30	148	P.L. 138	18.7 2"	46.0	---	C-0.1, N-0.04, Mn-4.4, Al-3.9	Annealed 1450°F in Argon.
31	"	"	"	"	---	"	"
32	"	"	"	"	---	"	"
33	"	"	"	"	---	"	"
34	"	"	"	"	---	"	"
35	138	P.L. 124	16.0 2"	40.0	---	C-0.1, N-0.05, Sn-2.58, Al-4.13	Annealed 1450°F in Argon.
36	"	"	"	"	---	"	"
37	"	"	"	"	---	"	"
38	"	"	"	"	---	"	"
39	"	"	"	"	---	"	"

Table XIII. Titanium Alloys (Continued)

Item	Ref.	Description			Fatigue Properties					Testing Machine			Specimen	
					K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Type	Kind of Test	Speed cpm	Size	Surface Finish
40	75	RC-A-3031A	Commercially Ground Square Notch. Fillet R = 0.010"		2.5	No	18±	---	10^7	R.R. Moore	Rotating Bending	6,000	0.250"ϕ	-----
41	76	Ti-75A	Without Coolant		1.0	No	50±	---	10^7	R.R. Moore	Rotating Bending	1,800 or 10,000	-----	-----
42	"	"	"		"	"	58±	---	"	"	"	400	-----	-----
43	"	"	With Coolant		"	"	55±	---	"	"	"	1,800	-----	-----
44	"	"	"		"	"	60±	---	"	"	"	10,000	-----	-----
45	77	Commercial Titanium	Grain Size 0.008± mm	Smooth	1.0	No	52.7	---	10^7	Krouse	Rotating Cantil.	8,000-10,000	0.150"	Hand Polish
46	"	"	"	Notch 0.037" Deep, R=0.005"	3.0	"	27.7	---	"	"	"	"	"	-----
47	"	"	Grain Size 0.02± mm	Smooth	1.0	"	51.2	---	"	"	"	"	"	Hand Polish
48	"	"	"	Notch 0.037" Deep, R=0.005"	3.0	"	27.7	---	"	"	"	"	"	-----
49	"	"	Grain Size 0.12± mm	Smooth	1.0	"	53.4	---	"	"	"	"	"	Hand Polish
50	"	"	"	Notch 0.037" Deep, R=0.005"	3.0	"	28.0	---	"	"	"	"	"	-----
51	"	Ti-7.5 Cr-7.5 Mo Alloy		Smooth	1.0	"	66.5	---	"	"	"	"	"	Hand Polish
52	"	"		Notch 0.037" Deep, R-0.005"	3.0	"	33.0	---	"	"	"	"	"	-----
53	"	"	Grain Size 0.008± mm	Smooth	1.0	"	57.2	---	"	"	"	"	"	Hand Polish

Table XIII. Titanium Alloys (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
40	138	P.L. 124	16.0 2"	40.0	---	C-0.1, N-0.05, Sn-2.58, Al-4.13	Annealed 1450°F in Argon.
41	86	65 0.2%	---	54.6	RC 23-24	C-0.025, N-0.061, Fe-0.19	------
42	"	"	---	"	"	"	------
43	"	"	---	"	"	"	------
44	"	"	---	"	"	"	------
45	64	50± 0.2%	48±	60±	---	N-0.014, C-0.03, Fe-0.29, O-0.10, H-31 ppm	Anneal 1290°F, 2 hrs. in Air.
46	"	"	"	"	---	"	"
47	"	48±	40±	70±	---	"	Anneal 1605°F, 16 hrs. in Argon.
48	"	"	"	"	---	"	"
49	"	"	"	"	---	"	Anneal 1650°F, 1 hr. in Argon.
50	"	"	"	"	---	"	"
51	144	125±	20±	40±	---	Cr-7.60, Mo-6.66, N-0.026, C-0.03, Fe-0.32, O-0.13, H-44 ppm.	Anneal 1290°F, 1 hr. in Air.
52	"	"	"	"	---	"	"
53	141	"	"	55±	---	"	Anneal 1830°F, 4 hrs. in Argon.

Table XIII. Titanium Alloys (Continued)

Item	Ref.	Description			Fatigue Properties					Testing Machine			Specimen	
					K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Type	Kind of Test	Speed cpm	Size	Surface Finish
54	77	Ti-7.5 Cr-7.5 Mo Alloy	Grain Size 0.008± mm	Notch 0.037" Deep,R-0.005"	3.0	No	32.6	---	10^7	Krouse	Rotating Cantil.	8,000-10,000	0.150"	-----
55	"	Ti-2.5 Cr-2.5 Mo Alloy	Grain Size 0.002± mm	Smooth	1.0	"	48.2	---	"	"	"	"	"	Hand Polish
56	"	"	"	Notch 0.037" Deep,R-0.005"	3.0	"	31.5	---	"	"	"	"	"	-----
57	"	"	Grain Size 0.004± mm	Smooth	1.0	"	49.1	---	"	"	"	"	"	Hand Polish
58	"	"	"	Notch 0.037" Deep,R-0.005"	3.0	"	27.8	---	"	"	"	"	"	-----
59	"	"	Grain Size 0.20 mm	Smooth	1.0	"	55	---	"	"	"	"	"	Hand Polish
60	"	"	"	Notch 0.037" Deep,R-0.005"	3.0	"	27.2	---	"	"	"	"	"	-----
61	"	"	Grain Size 0.40 mm	Smooth	1.0	"	48	---	"	"	"	"	"	Hand Polish
62	"	"	"	Notch 0.037" Deep,R=0.005"	3.0	"	28.2	---	"	"	"	"	"	-----
63	78	6 Al-4 Va Titanium Alloy		Smooth	1.0	No	83±	---	10^7	R.R. Moore	Rotating Bending	10,000	-----	Hand Polish
64	"	"		"	1.0	"	96±	---	"	"	"	"	-----	"
65	29	6 Al-4 Va Titanium Alloy		Smooth	1.0	No	83.6	5.4	$5(10^7)$	R.R. Moore	Rotating Bending	12,000	0.230"ø	-----
66	38	6 Al-4 V Titanium Alloy Bar			1.0	61	61	---	10^6	-----	Axial	-----	-----	-----

Table XIII. Titanium Alloys (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
54	141	125±	20±	55±	---	Cr-7.60, Mo-6.66, N-0.026, C-0.03, Fe-0.32, O-0.13, H-44 ppm.	Anneal 1830°F, 4 hrs. in Argon.
55	109	95±	32±	60±	---	Cr-2.32, Mo-2.58, N-0.015, C-0.04, Fe-0.27, O-0.13, H-60 ppm	1380°F, 1 hr., FC to 1200°F, AC.
56	"	"	"	"	---	"	"
57	102	90±	28±	58±	---	"	1380°F, 64 hrs., FC to 1200°F, AC.
58	"	"	"	"	---	"	"
59	106	90±	26±	48±	---	"	1650°F, 30 min., FC to 1380°F, hold 1 hr., FC to 1200°F, AC.
60	"	"	"	"	---	"	"
61	108	"	"	39±	---	"	1830°F, 1 hr., FC to 1380°F, hold 1 hr., FC to 1200°F, AC.
62	"	"	"	"	---	"	"
63	142	---	---	---	---	Al-6.09, V-4.06, Fe-0.147, N_2-0.013, C-0.015, H_2-0.004	1300°F, 2 hrs.
64	167	---	---	---	---	"	1750°F, 1 hr., WQ; 1100°F, 2 hrs.
65	145	138	15	39	RC 34	Al-5.5, V-3.9, N-0.01, C $<$ 0.10	Not reported - heat treated by vendor.
66	160	---	---	---	---	------	------

Table XIII. Titanium Alloys (Continued)

Item	Ref.	Description		Fatigue Properties: Kt	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Testing Machine: Type	Kind of Test	Speed cpm	Specimen: Size	Surface Finish
67	79	7 Al-3 Mo Titanium Alloy, Aged	75°F Tests.	1.0	0	80±	---	2.16(10^7) (100 hrs)	-----	Axial	3,600	0.19"ϕ	Polished, with Coolant
68	"	"	"	"	54	54	---	"	-----	"	"	"	"
69	"	"	"	"	64	43±	---	"	-----	"	"	"	"
70	"	7Al-3 Mo Titanium Alloy, Annealed	"	"	0	82±	---	"	-----	"	"	"	"
71	"	7Al-3 Mo Titanium Alloy, Aged	400°F Tests.	"	0	69±	---	"	-----	"	"	0.220-0.230"ϕ	"
72	"	"	600°F Tests.	"	0	61±	---	"	-----	"	"	"	"
73	"	"	"	"	59	39±	---	"	-----	"	"	"	"
74	"	7Al- 3Mo Titanium Alloy, Annealed	"	"	0	59±	---	"	-----	"	"	"	"
75	"	7Al-3 Mo Titanium Alloy, Aged	800°F Tests.	"	0	59±	---	"	-----	"	"	"	"
76	"	"	"	"	42	42±	---	"	-----	"	"	"	"
77	"	"	"	"	55	37±	---	"	-----	"	"	"	"
78	"	7Al-3 Mo Titanium Alloy, Annealed	"	"	0	56±	---	"	-----	"	"	"	"
79	"	"	"	"	33	33±	---	"	-----	"	"	"	"
80	"	"	"	"	55	37±	---	"	-----	"	"	"	"
81	"	7Al-3 Mo Titanium Alloy, Aged	1000°F Tests.	"	0	54±	---	"	-----	"	"	"	"

Table XIII. Titanium Alloys (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
67	---	---	---	---	---	------	1560°F in Argon, 30 min., AC; 1020°F, 24 hrs., AC.
68	---	---	---	---	---	------	"
69	---	---	---	---	---	------	"
70	---	---	---	---	---	------	1450°F in Argon, 1 hr.; Cool to 1050°F (100°F p. hr. max.).
71	---	---	---	---	---	------	1560°F in Argon, 30 min., AC; 1020°F, 24 hrs., AC.
72	---	---	---	---	---	------	"
73	---	---	---	---	---	------	"
74	---	---	---	---	---	------	1450°F in Argon, 1 hr.; Cool to 1050°F (100°F p. hr. max.).
75	---	---	---	---	---	------	1560°F in Argon, 30 min., AC; 1020°F, 24 hrs., AC.
76	---	---	---	---	---	------	"
77	---	---	---	---	---	------	"
78	---	---	---	---	---	------	1450°F in Argon, 1 hr.; Cool to 1050°F (100°F p. hr. max.).
79	---	---	---	---	---	------	"
80	---	---	---	---	---	------	"
81	---	---	---	---	---	------	1560°F in Argon, 30 min., AC; 1020°F, 24 hrs., AC.

Table XIII. Titanium Alloys (Continued)

Item	Ref.	Description		Fatigue Properties					Testing Machine			Specimen	
				K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Type	Kind of Test	Speed cpm	Size	Surface Finish
82	79	7Al-3 Mo Titanium Alloy, Aged	1000°F Tests.	1.0	31	31±	---	$2.16(10^7)$ (100 hrs.)	-----	Axial	3,600	0.220-0.230"ϕ	Polished, with Coolant
83	"	"	"	"	43	29±	---	"	-----	"	"	"	"
84	"	7Al-3 Mo Titanium Alloy, Annealed	"	"	0	51±	---	"	-----	"	"	"	"
85	"	"	"	"	33	33±	---	"	-----	"	"	"	"
86	"	"	"	"	41	27±	---	"	-----	"	"	"	"

Table XIII. Titanium Alloys (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical Composition	Heat Treatment
82	---	---	---	---	---	------	1560°F in Argon, 30 min., AC; 1020°F, 24 hrs., AC.
83	---	---	---	---	---	------	"
84	---	---	---	---	---	------	1450°F in Argon, 1 hr.; Cool to 1050°F (100°F p. hr. max.).
85	---	---	---	---	---	------	"
86	---	---	---	---	---	------	"

Table XIV. Miscellaneous Materials

Item	Ref.	Description		Fatigue Properties K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Testing Machine Type	Kind of Test	Speed cpm	Specimen Size	Surface Finish
1	8	Ingot Iron		1.0	No	34.0	---	10^7	R.R. Moore	Rotating Bending	3,600	0.25"	2/0 Emery
2	"	"		"	"	23.0	---	"	"	"	"	"	"
3	4	Gray Iron	Smooth	1.0	No	9.5	---	$2(10^7)$	-----	Rotating Cantil.	1,500±	0.58"±ϕ	-----
4	"	"	60° V-notch R = 0.010"	3.9	"	9.5	---	"	-----	"	"	0.58" ϕ	-----
5	29	Al-Ni-Bronze	Smooth	1.0	No	48	4.5	$5(10^7)$	R.R. Moore	Rotating Bending	12,000	0.300"ϕ	3-5 micro-in.
6	"	Beryllium Copper	Smooth	"	"	36.5	2.7	"	"	"	"	"	"
7	80	Glass-Fiber-Reinforced Plastic Laminate 73°F,50% Rel.Humidity, 0° to Warp.	Smooth	1.0	"	10.4	---	10^7	-----	Push-Pull	900	1/2" x 0.233"	-----
8	"	"	Smooth	1.0	"	10.4	---	"	-----	"	"	1/2" x 0.223"	-----
9	"	"	1/8"ϕ Hole.	3.5	"	7.6	---	"	-----	"	"	"	-----
10	"	"	Smooth	1.0	"	11.0	---	"	-----	"	"	1/2" x 0.246"	-----
11	"	"	1/8"ϕ Hole.	3.5	"	8.7	---	"	-----	"	"	"	-----
12	"	"	Smooth	1.0	"	10.9	---	"	-----	"	"	1/2" x 0.261"	-----

Table XIV. Miscellaneous Materials (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical, or Other, Composition	Heat, or Other, Treatment
1	62.9	54	18 2"	65.6	---	C-0.012, Mn-0.017, P-0.005, S-0.025	Tested as received, hot rolled.
2	55.1	33	21.5	66.5	RB 54	"	1400°F, 1 hr., W.Q.
3	20.3	---	---	---	---	C-3.65, Mn-0.73, Si-2.46, P-0.265, S-0.132	Tested as cast.
4	"	---	---	---	---	"	"
5	116	85	18±	28±	Rc 20	Cu-81.75, Mn-0.71, Fe-2.86, Ni-4.69, Al-9.90	By vendor.
6	175	149	4.3	5.9	Rc 37	Cu-97.46, Be-2.08, Co+Ni-0.40	By vendor. Also, age-hardened 600°F, 3 hrs., AC.
7	52.2	9.4 Prop. Lim.	---	---	Barcol 70	Polyester resin (Paraplex P43), 34.3%, reinf. w. "181 glass fabric", 23 plies.	14 psi, 220°-250°F, 90 min.
8	46.3	11.7 P.L.	---	---	B.73	Polyester resin (Paraplex P43), 37.8% reinf. w. "112 glass fabric", 84 plies.	"
9	"	"	---	---	"	"	"
10	45.7	13.0 P.L.	---	---	B.72	Polyester resin (Paraplex P43), 38.6%, reinf. w. "120 glass fabric", 64 plies.	"
11	"	"	---	---	"	"	"
12	50.3	9.8 P.L.	---	---	B.70	Polyester resin (Paraplex P43), 29.5%, reinf. w. "184 glass fabric", 10 plies.	"

Table XIV. Miscellaneous Materials (Continued)

Item	Ref.	Description		Fatigue Properties K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Testing Machine Type	Kind of Test	Speed cpm	Specimen Size	Surface Finish
13	80	Glass-Fiber-Reinforced Plastic Laminate 73°F, 50% Rel.Humidity, 0° to Warp	1/8"ϕ Hole.	3.5	No	8.6	---	10^7	-----	Push-Pull	900	1/2" x 0.261"	-----
14	"	"	Smooth	1.0	"	3.5	---	"	-----	"	"	1/2" x 0.234"	-----
15	"	"	1/8"ϕ Hole.	3.5	"	4.5	---	"	-----	"	"	"	-----
16	"	"	Smooth	1.0	"	16.1	---	"	-----	"	"	1/2" x 0.247"	-----
17	"	"	1/8"ϕ Hole.	3.5	"	14.2	---	"	-----	"	"	"	-----
18	"	Heat Resistant Glass-Fiber-Reinf. Plastic Laminate, 73°F,50% Rel. Humidity, 0° to Warp	Smooth	1.0	"	10.3	---	"	-----	"	"	1/2" x 0.222"	-----
19	"	"	"	"	9.2	5.0	---	"	-----	"	"	"	-----
20	"	"	"	"	23.0	2.4	---	"	-----	"	"	"	-----
21	"	"	1/8"ϕ Hole.	3.5	No	8.0	---	"	-----	"	"	"	-----
22	"	"	"	"	7.0	3.5	---	"	-----	"	"	"	-----
23	"	"	"	"	17.6	1.5	---	"	-----	"	"	"	-----
24	"	Heat Resistant Glass-Fiber-Reinf. Plastic Laminate, 73°F,50% Rel. Humidity, 45° to Warp.	Smooth	1.0	No	6.4	---	"	-----	"	"	"	-----

Table XIV. Miscellaneous Materials (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical, or Other, Composition	Heat, or Other, Treatment
13	50.3	9.8 P.L.	---	---	B.70	Polyester resin (Paraplex P43), 29.5%, reinf. w. "184 glass fabric", 10 plies	14 psi, 220°-250°F, 90 min.
14	12.0	5.2 P.L.	---	---	B.59	Polyester resin (Paraplex P43), 58.3% reinf. w. "glass mat", 7 plies	"
15	"	"	---	---	"	"	"
16	49.0	27.8 P.L.	---	---	B.71	Epoxide resin (Epon 828-14% CL), 37.7%, reinf. w. "181 glass fabric", 24 plies	0 psi, 212°F, 10 min.; 50 psi, 212°F, 25 min.; 0 psi, 400°F, 120 min.
17	"	"	---	---	"	"	"
18	46.2	18.0 P.L.	---	---	B.74	Polyester resin (PDL 7-669), 35.3%, reinf. w. "181 glass fabric", 23 plies	14 psi, 220°F, 45 min.; 0 psi, 500°F, 180 min.
19	"	"	---	---	"	"	"
20	"	"	---	---	"	"	"
21	"	"	---	---	"	"	"
22	"	"	---	---	"	"	"
23	"	"	---	---	"	"	"
24	"	"	---	---	"	"	"

Table XIV. Miscellaneous Materials (Continued)

Item	Ref.	Description		Fatigue Properties					Testing Machine			Specimen	
				Kt	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Type	Kind of Test	Speed cpm	Size	Surface Finish
25	80	Heat Resistant Glass-Fiber-Reinf. Plastic Laminate, 73°F, 50% Rel. Humidity, 0° to Warp.	Smooth	1.0	No	10.9	---	10^7	-----	Push-Pull	900	1/2" x 0.221"	-----
26	"	"	1/8"ϕ Hole.	3.5	"	10.7	---	"	-----	"	"	"	-----
27	"	"	Smooth	1.0	"	12.5	---	"	-----	"	"	1/2" x 0.257"	-----
28	"	"	1/8"ϕ Hole.	3.5	"	10.0	---	"	-----	"	"	"	-----
29	"	"	Smooth	1.0	"	7.9	---	"	-----	"	"	1/2" x 0.261"	-----
30	"	"	1/8"ϕ Hole.	3.5	"	6.9	---	"	-----	"	"	"	-----
31	42	Glass Fabric Laminate Plastic, 0° to Warp, Room Temp.	Smooth	1.0	No	10.5	---	$2x10^7$	-----	Rotating Cant.	---	0.275"ϕ	-----
32	81	Yellow Birch Natural	Smooth	1.0	No	4.0	---	10^8	R.R. Moore	Rotating Bending	3,450	0.330"ϕ	No. 00 Emery
33	"	Hard Maple Natural	"	"	"	6.2	---	"	"	"	"	"	"
34	"	Yellow Birch Laminated	"	"	"	11.4	---	"	"	"	10,600	"	"
35	"	"	60° V-notch R = 0.010"	2.8	"	9.7	---	"	"	"	"	"	"
36	"	Hard Maple Laminated	Smooth	1.0	"	10.0	---	"	"	"	3,450	"	"

Table XIV. Miscellaneous Materials (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical, or Other, Composition	Heat, or Other, Treatment
25	42.6	13.8 P.L.	---	---	B.74	Epoxide resin (Epon X12100-4%E), 35.0%, reinf. w. "181 glass fabric", 24 plies	0 psi, 310°F, 3 min.; 200 psi, 42 min.; 0 psi, 400°F, 1440 min.
26	"	"	---	---	"	"	"
27	47.9	12.8 P.L.	---	---	B.81	Phenolic resin (BV17085), 28.0%, reinf. w. "181 glass fabric", plies	-----
28	"	"	---	---	"	"	-----
29	37.7	21.0 P.L.	---	---	B.63	Silicone resin (DC2106), 31.0%, reinf. w. "181 glass fabric", 28 plies	-----
30	"	"	---	---	"	"	-----
31	40	---	---	---	---	CTL-91-LB Resin, 181-114 Fiberglass Fabric	Pressed at approx. 15 psi into 1 1/4 inch panel.
32	Bend. 19.6	---	---	---	---	Solid (non-laminated)	None. Spec. gravity 0.69.
33	Bend. 21.7	---	---	---	---	"	None. Spec. gravity 0.70.
34	Bend. 31.0	---	---	---	---	1/16 inch laminations, Impregnated. Phenolic resin content 35%.	Compressed 50%; to spec. grav. 1.25.
35	"	---	---	---	---	"	"
36	Bend. 41.0	---	---	---	---	1/8-inch laminations. Non-impregnated.	Compressed 50%, to spec. grav. 1.38. Phenolic resin paper bonding.

Table XIV. Miscellaneous Materials (Continued)

Item	Ref.	Description		Fatigue Properties Kt	Sm ksi	Se ksi	St. Dev.	Life, Cycles	Testing Machine Type	Kind of Test	Speed cpm	Specimen Size	Surface Finish
37	81	Hard Maple Laminated	60° V-notch, R = 0.010"	2.8	No	8.0	---	10^8	R.R. Moore	Rotating Bending	3,450	0.330"ϕ	No. 00 Emery
38	"	"	Smooth	1.0	"	4.0	---	"	"	"	"	"	"
39	"	"	60° V-notch, R = 0.010"	2.8	"	3.2	---	"	"	"	"	"	"
40	"	"	Smooth	1.0	"	10.4	---	"	"	"	3,450	"	"
41	"	"	"	"	"	10.0	---	"	"	"	10,600	"	"
42	"	"	60° V-notch, R = 0.010"	2.8	"	9.0	---	"	"	"	3,450	"	"
43	"	"	"	"	"	8.4	---	"	"	"	10,600	"	"
44	"	"	Smooth	1.0	"	10.9	---	"	"	"	3,450	"	"
45	"	"	"	"	"	10.3	---	"	"	"	10,600	"	"
46	"	"	60° V-notch, R = 0.010"	2.8	"	9.8	---	"	"	"	3,450	"	"
47	"	"	"	"	"	9.0	---	"	"	"	10,600	"	"
48	82	Solid Sitka spruce and Douglas-fir. Approx. 12% moisture content.		---	---	27% of mod.of	---	5(107)	Krouse	Const. Defl.	1,790	9"x1-1/4" x 3/8"	-----
49	"	Plywoods of Yellow Birch and Yellow Poplar. Approx. 12% moisture content.		---	---	"	---	"	"	"	"	9"x1-1/4" x 5/16"	-----
50	83	Brush QMV Beryllium. Room Temperature		1.0	No	33	---	$2x10^7$	-----	Rotating Bending	-----	-----	-----

Table XIV. Miscellaneous Materials (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical, or Other, Composition	Heat, or Other, Treatment
37	Bend. 41.0	---	---	---	---	1/8-inch laminations. Non-impregnated.	Compressed 50%, to spec. grav. 1.38. Phenolic resin paper bonding.
38	Bend. 19.0	---	---	---	---	1/8-inch laminations. Non-impregnated.	Non-compressed. Spec. gravity 0.68. Phenolic resin paper bonding.
39	"	---	---	---	---	"	"
40	Bend. 41.0	---	---	---	---	1/8-inch laminations. Impregnated. Phenolic resin content 12%.	Compressed 50%, to spec. grav. 1.23.
41	"	---	---	---	---	"	"
42	"	---	---	---	---	"	"
43	"	---	---	---	---	"	"
44	"	---	---	---	---	1/8-inch laminations. Impregnated. Phenolic resin content 23%.	Compressed 50%, to spec. grav. 1.31.
45	"	---	---	---	---	"	"
46	"	---	---	---	---	"	"
47	"	---	---	---	---	"	"
48	---	---	---	---	---	Clear, straight-grained.	Tested at 75°F and 65% relative humidity.
49	---	---	---	---	---	Five 5/16" plies, with thermosetting Phenol-formaldehyde Tego film glue.	"
50	40.7	36.4 0.2%	---	---	---	Be-98.6, BeO-1.49, Fe-0.12, Al-0.037, Mg-0.032, Ni-0.012	None

Table XIV. Miscellaneous Materials (Continued)

Item	Ref.	Description			Fatigue Properties					Testing Machine			Specimen	
					K_t	S_m ksi	S_e ksi	St. Dev.	Life, Cycles	Type	Kind of Test	Speed cpm	Size	Surface Finish
51	84	Brush QMV Beryllium	Hot Pressed, Hot Extruded	Stress-Rupture 1100°F	1.0	4.5±	0	---	2000 hours	-----	Axial	-----	-----	-----
52	85	"	Hot Pressed	Room Temperature	"	22±	15±	---	10^7	-----	"	-----	-----	-----
53	"	"	"	"	?	16±	10±	---	"	-----	"	-----	-----	-----
54	"	"	Hot Pressed, Hot Extruded	"	1.0	33±	22±	---	"	-----	"	-----	-----	-----
55	"	"	"	"	?	26±	17±	---	"	-----	"	-----	-----	-----
56	"	"	Hot Pressed	1100°F	1.0	No	10.5	---	"	-----	"	-----	-----	-----
57	"	"	"	"	?	"	6	---	"	-----	"	-----	-----	-----
58	"	"	Hot Pressed, Hot Extruded	"	1.0	"	16	---	$5x10^5$	-----	"	-----	-----	-----
59	"	"	"	"	?	"	9	---	10^7	-----	"	-----	-----	-----
60	"	"	Hot Pressed	"	1.0	5.5±	3.5±	---	"	-----	"	-----	-----	-----
61	"	"	"	"	?	5.5±	3.5±	---	"	-----	"	-----	-----	-----
62	"	"	Hot Pressed, Hot Extruded	"	1.0	7 ±	5 ±	---	"	-----	"	-----	-----	-----
63	"	"	"	"	?	7 ±	5 ±	---	"	-----	"	-----	-----	-----

Table XIV. Miscellaneous Materials (Continued)

Item	Static Properties UTS ksi	YP ksi	Elong. %	R.A. %	Hard.	Chemical, or Other, Composition	Heat, or Other, Treatment
51	---	---	---	---	---	------	------
52	---	---	---	---	---	------	------
53	---	---	---	---	---	------	------
54	---	---	---	---	---	------	------
55	---	---	---	---	---	------	------
56	---	---	---	---	---	------	------
57	---	---	---	---	---	------	------
58	---	---	---	---	---	------	------
59	---	---	---	---	---	------	------
60	---	---	---	---	---	------	------
61	---	---	---	---	---	------	------
62	---	---	---	---	---	------	------
63	---	---	---	---	---	------	------

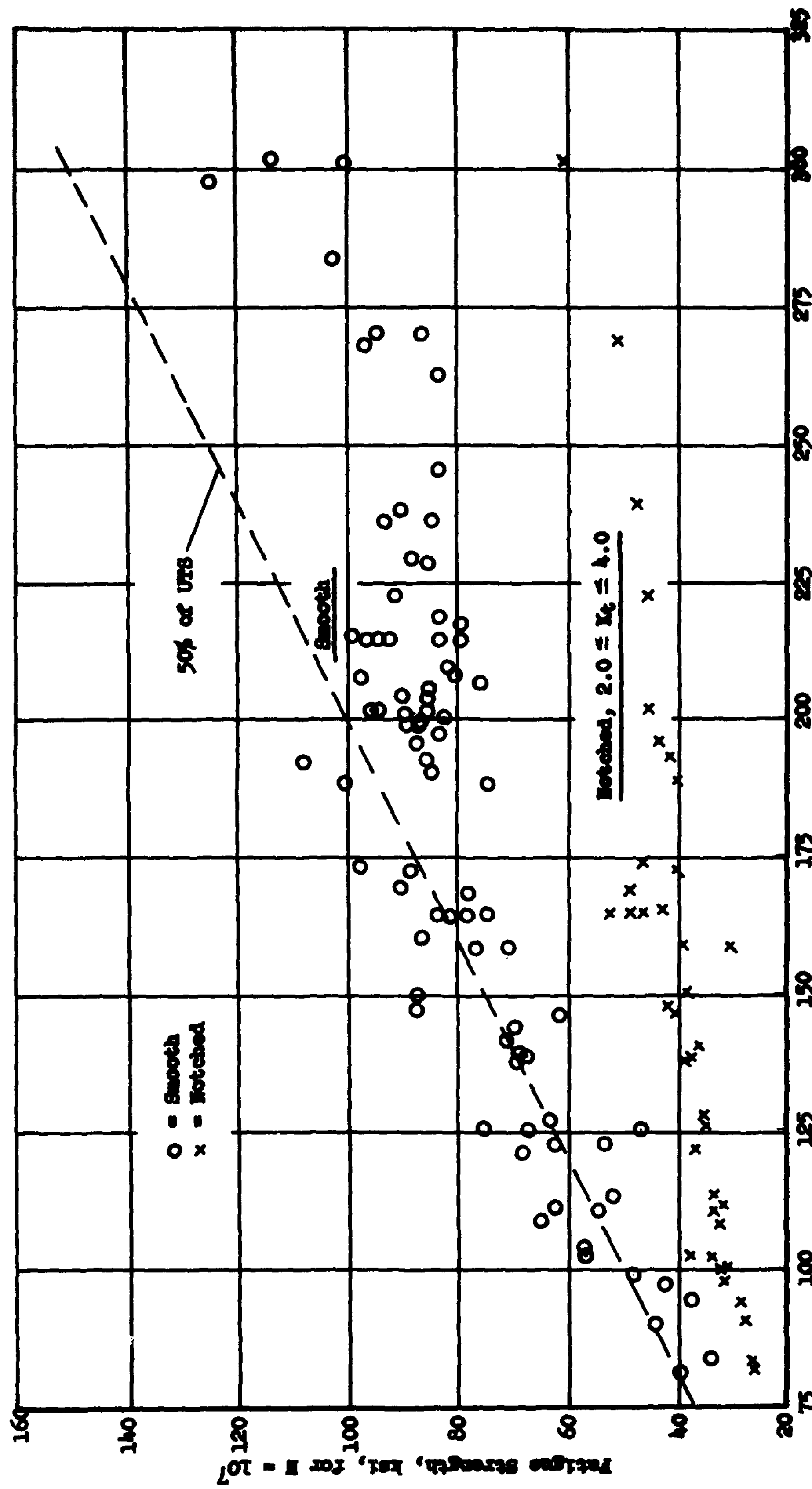

Fig. 1

Fatigue Strength of Steels vs. Ultimate Tensile Strength

(Plotted from Tables I to IV)

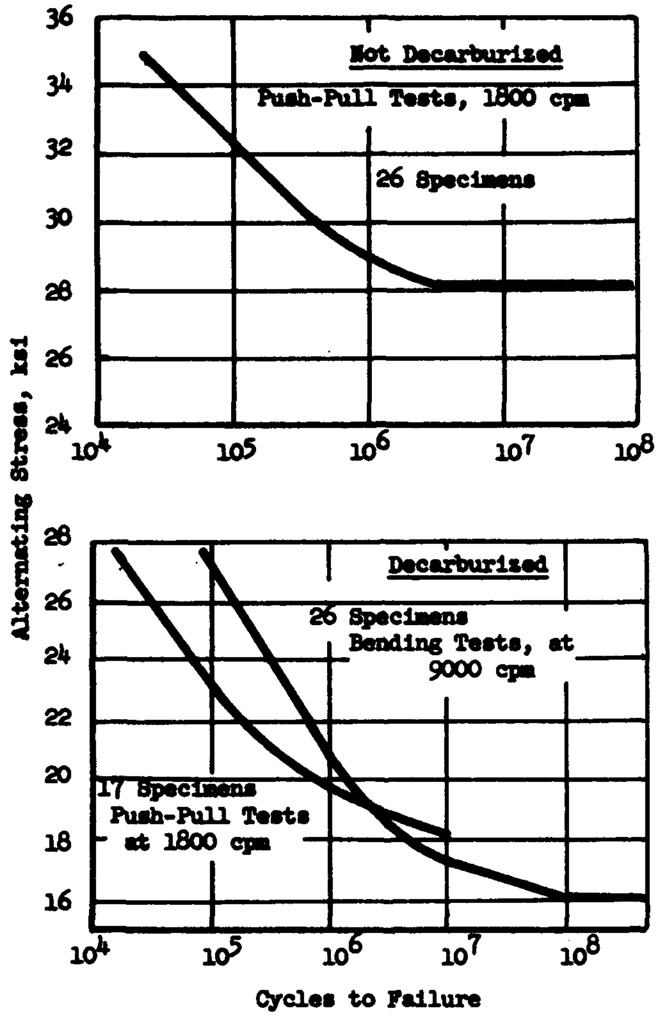

Fig. 2

S-N Curves for SAE 1008 Steel, Decarburized and Not Decarburized

(From ref. 3)

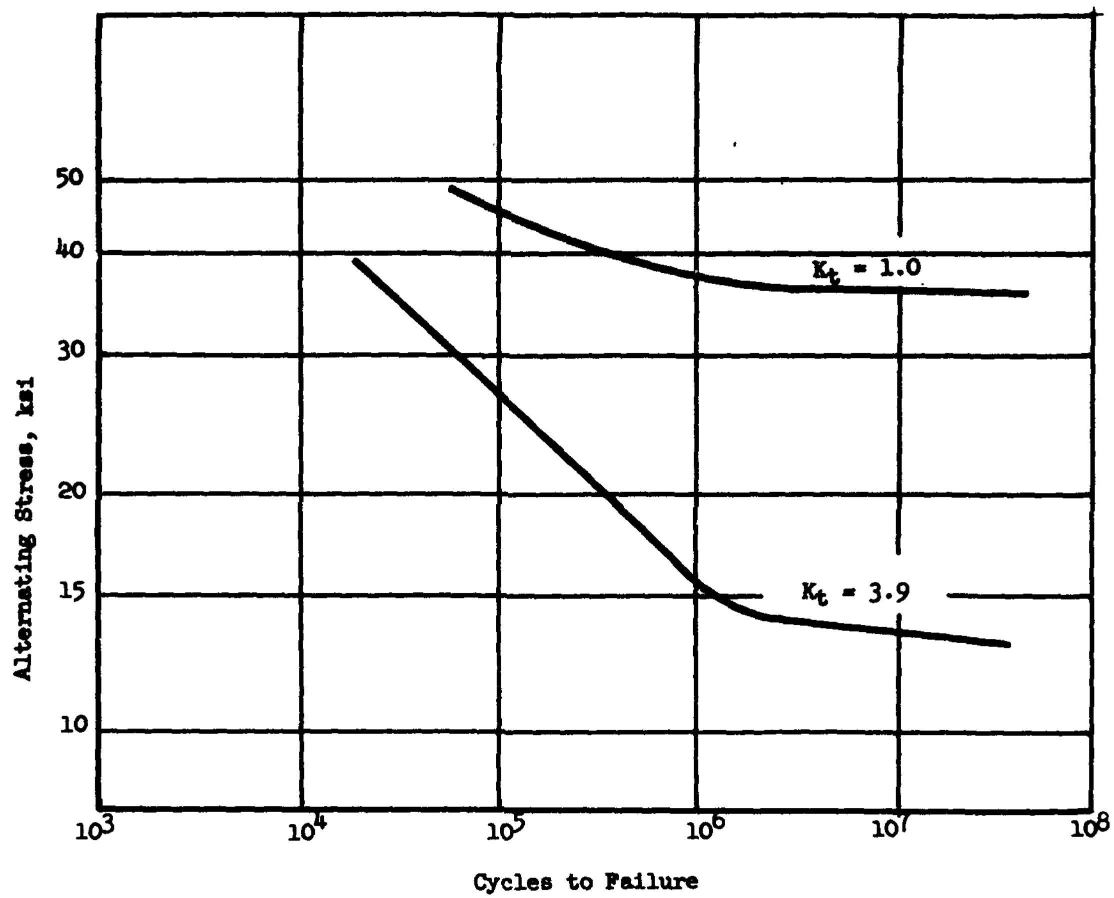

Fig. 3

S-N Curves for 1020 Steel

(From Ref. 4)

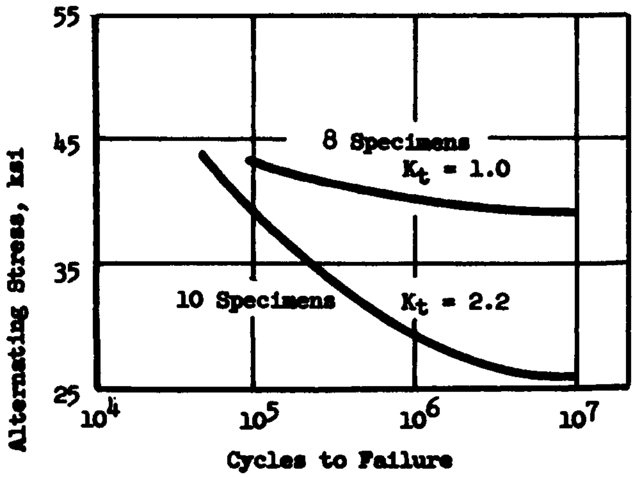

Fig. 4

S-N Curves for 1040 Wrought Steel,

Annealed,

81.4 ksi UTS

(From ref. 5)

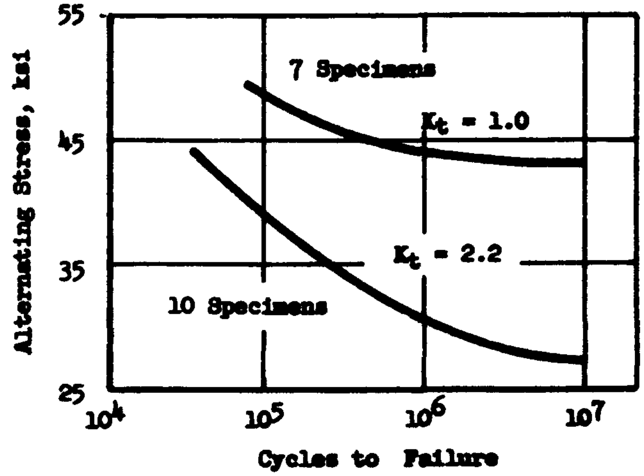

Fig. 5

S-N Curves for 1040 Wrought Steel,

Normalized and Tempered,

90 ksi UTS

(From ref. 5)

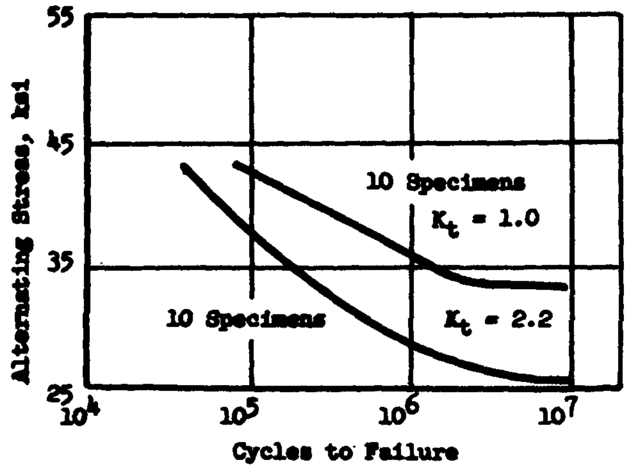

Fig. 6
S-N Curves for 1040 Cast Steel,
Annealed,
83.5 ksi UTS
(From ref. 5)

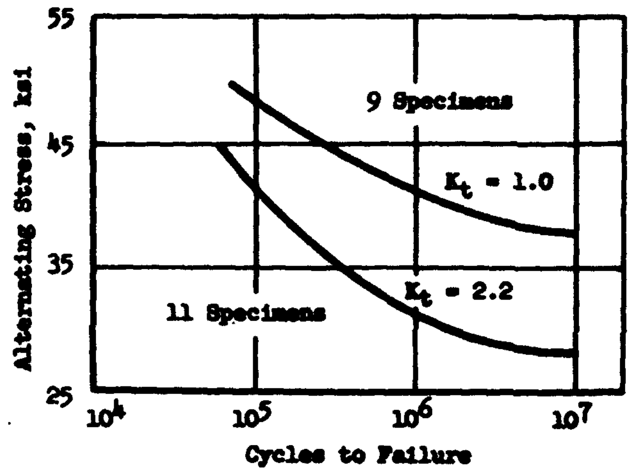

Fig. 7
S-N Curves for 1040 Cast Steel,
Normalized and Tempered,
94.2 ksi UTS
(From ref. 5)

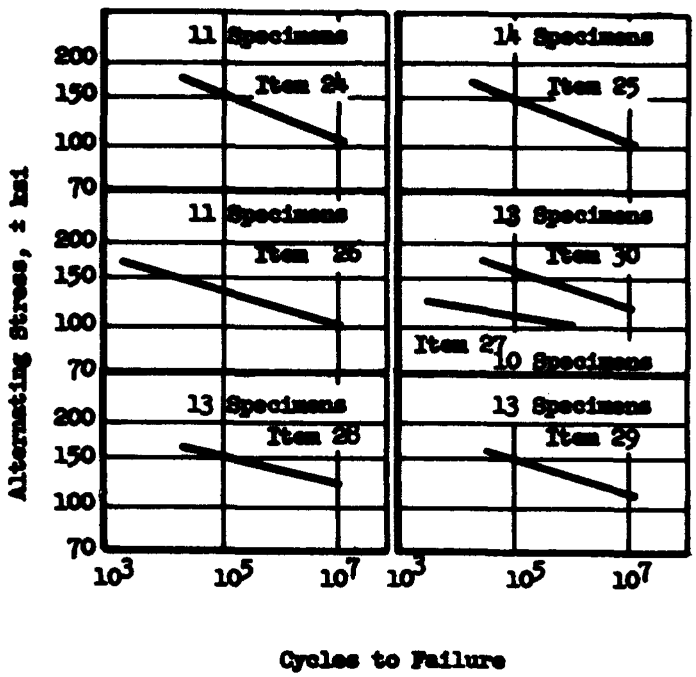

Fig. 8

S-N Curves - Carburized 2315 Steel, Smooth

(From Ref. 6)

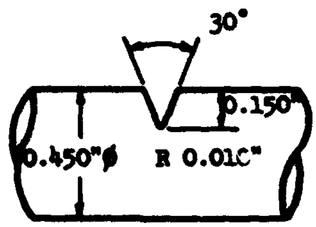

Fig. 9

Design of Notch Used For Fatigue Tests of Carburized Steels

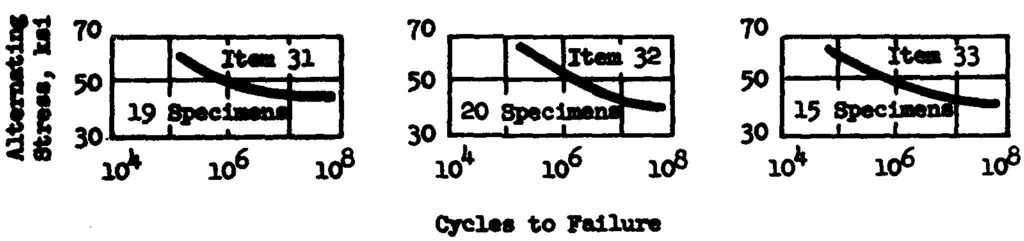

Fig. 10

S-N Curves - Notched 2315 Carburized Steel

(Stresses are arbitrary and may be misleading)

(From Ref. 6)

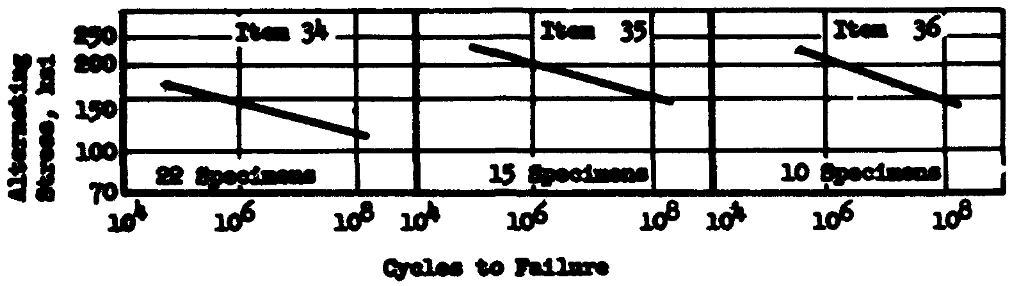

Fig. 11

S-N Curves - Smooth 2330 Carburized Steel

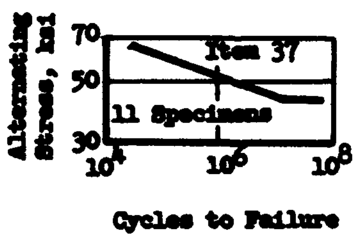

Fig. 12

S-N Curves - Notched 2330 Carburized Steel

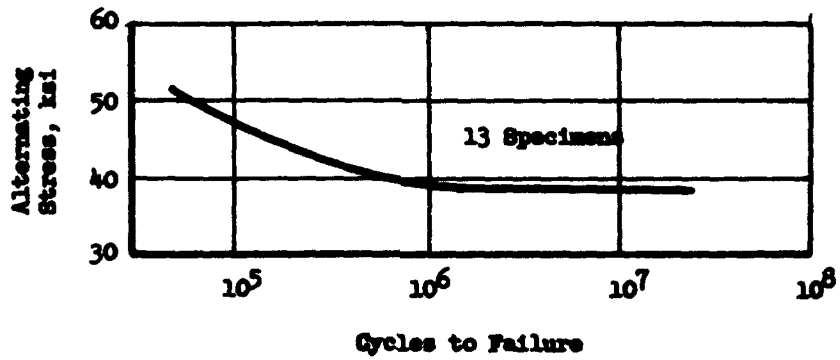

Fig. 13

S-N Curve for SAE 2340 Steel, Notched

(From Ref. 8)

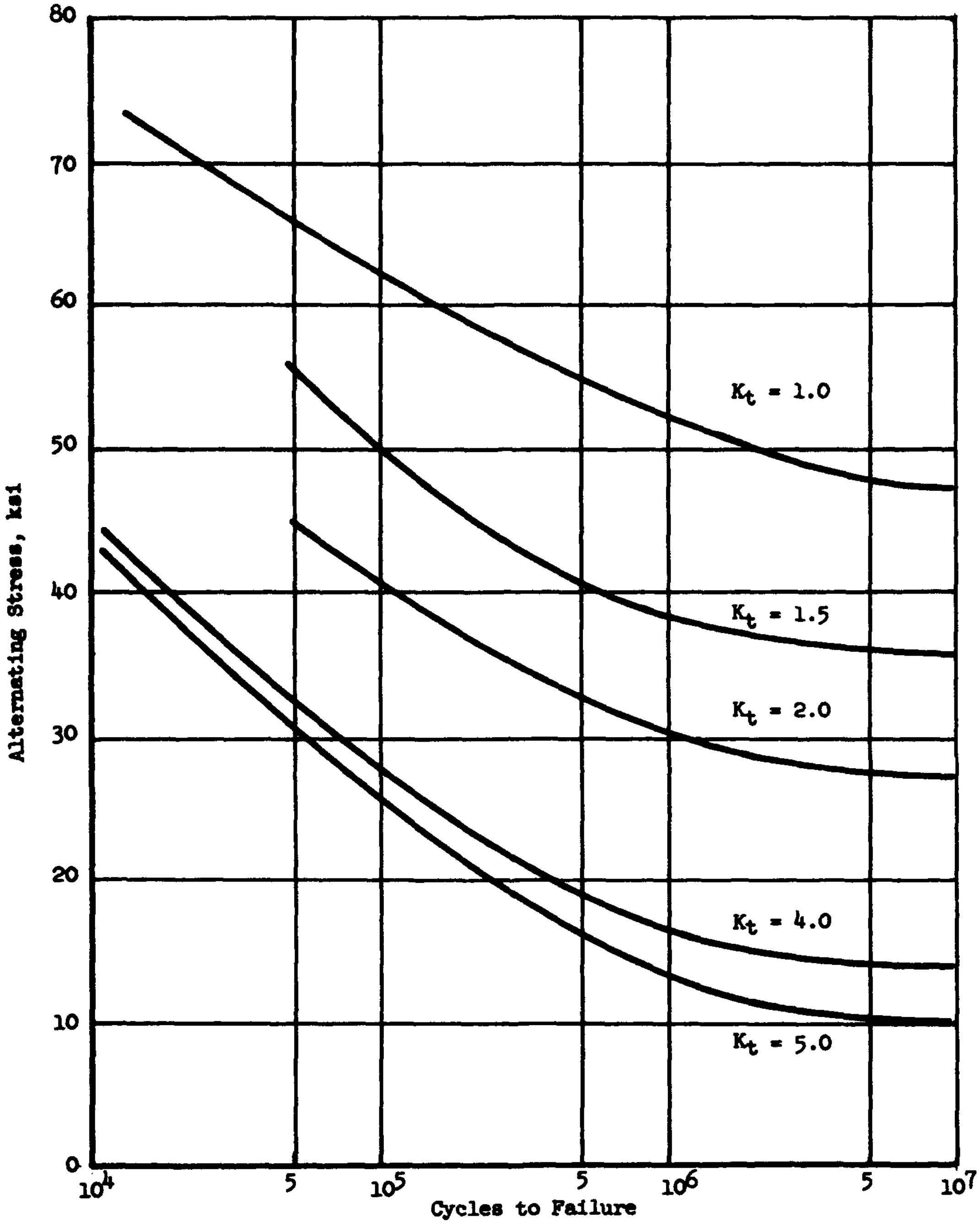

Fig. 14

Approximate S-N Curves for Normalized 4130 Steel.
Fully Reversed Axial Stresses

(Plotted from Table 7 of Ref. 10)

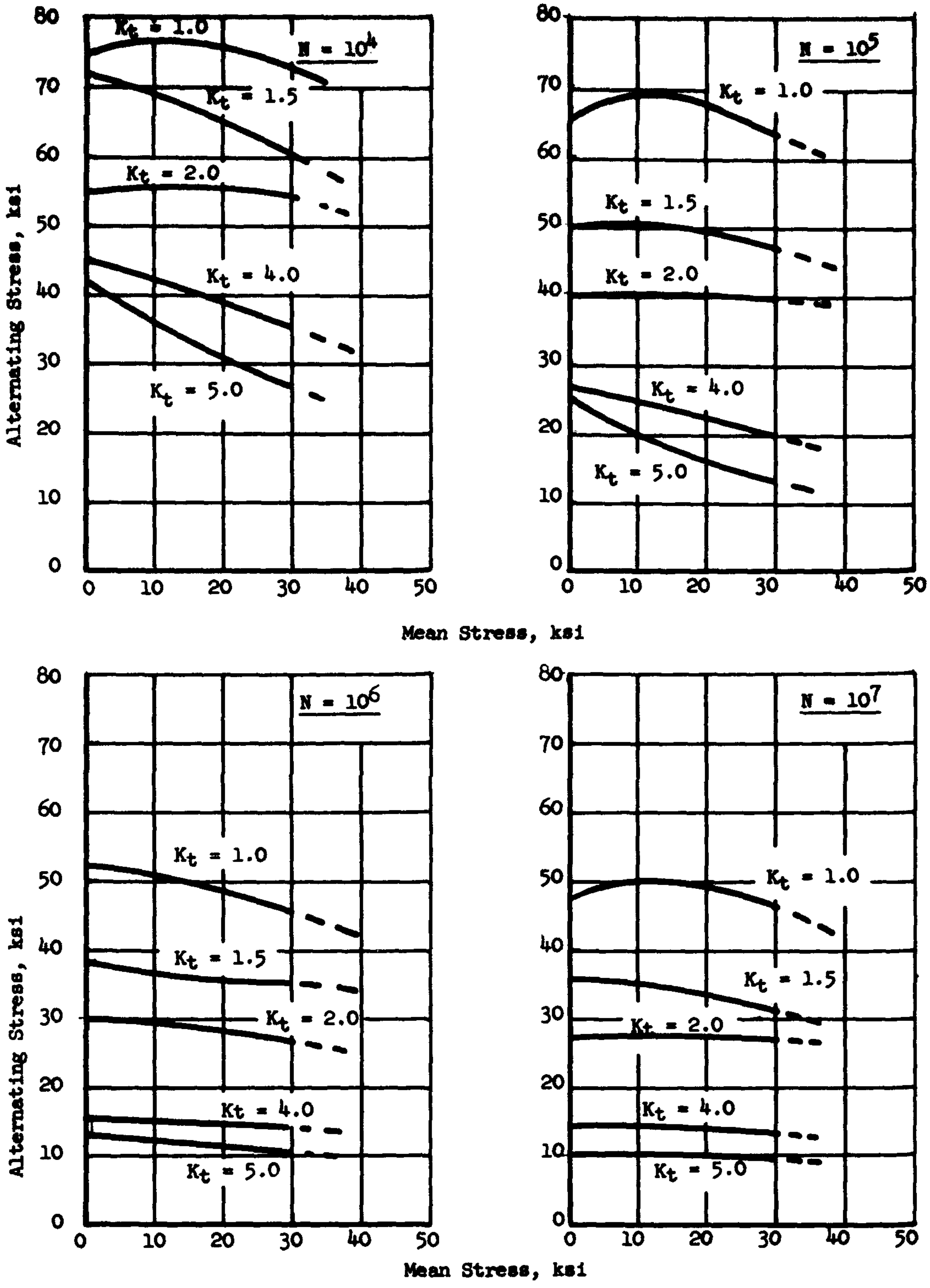

Fig. 15

Alternating vs. Mean Stress, for Normalized 4130 Steel Axial Stresses

(Plotted from Table 7 of Ref. 10)

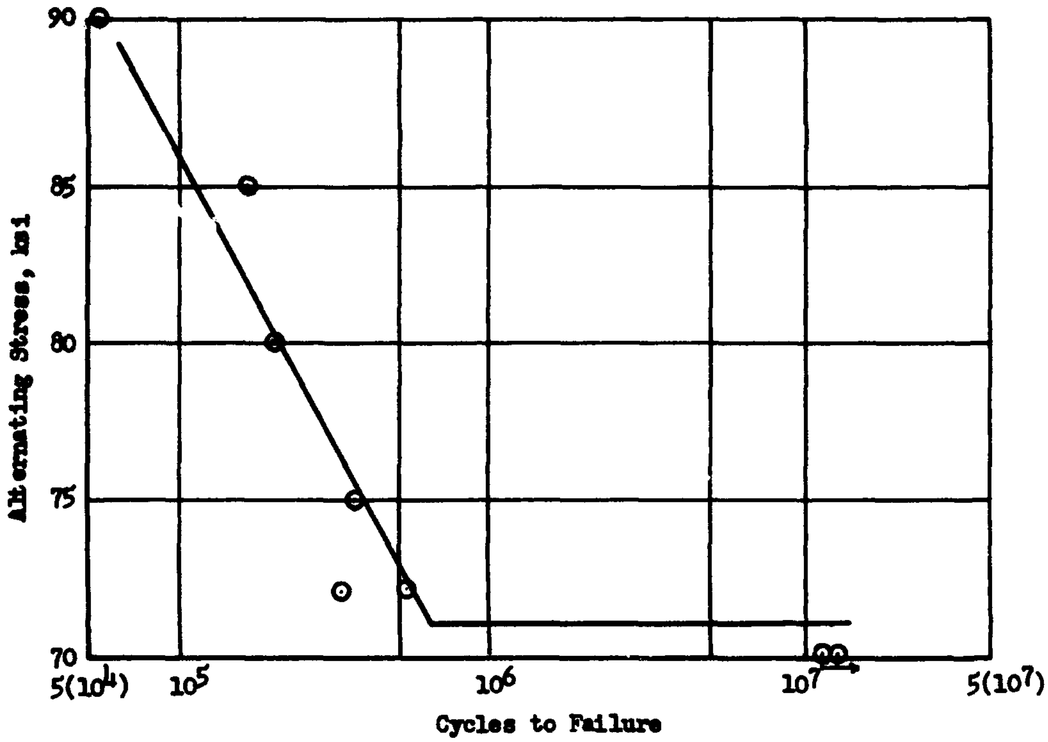

Fig. 16

S-N Curve - Steel SAE 4320 - "Transverse" Specimens

(Traced from ref. 11)

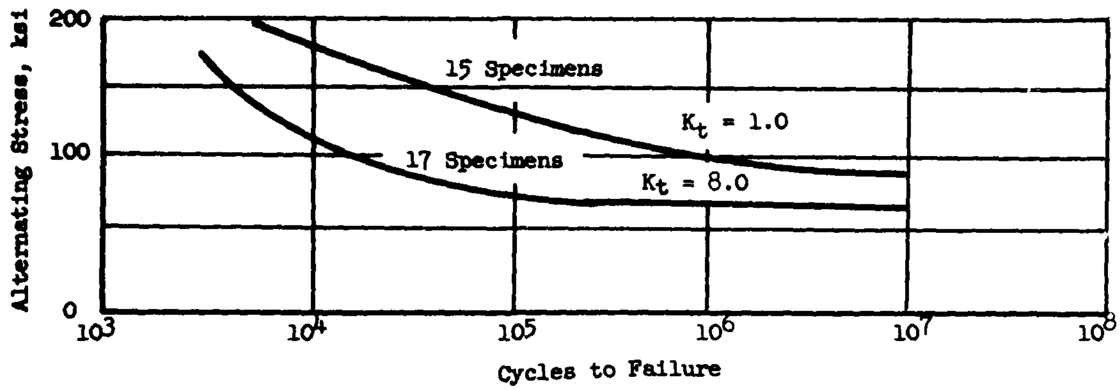

Fig. 17

S-N Curves for V-Modified 4330 Steel, 263 ksi UTS

(From Ref. 13)

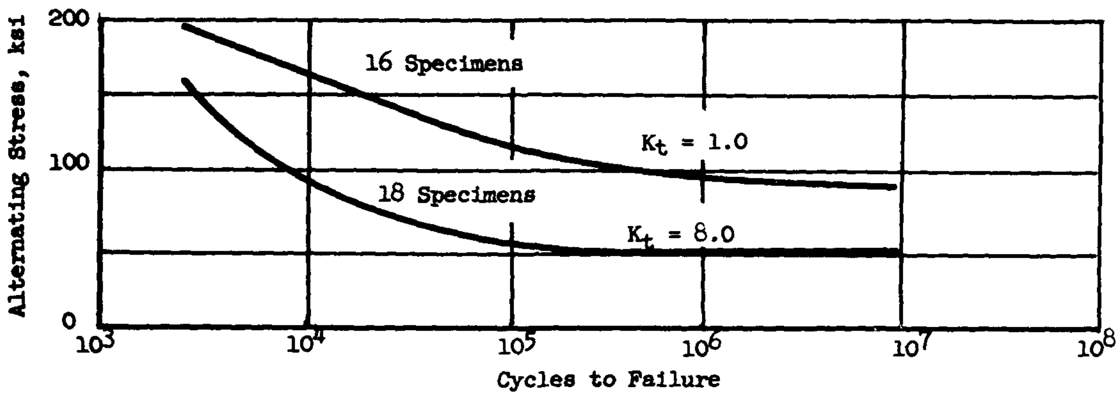

Fig. 18

S-N Curves for V-Modified 4330 Steel, 250 ksi UTS

(From Ref. 13)

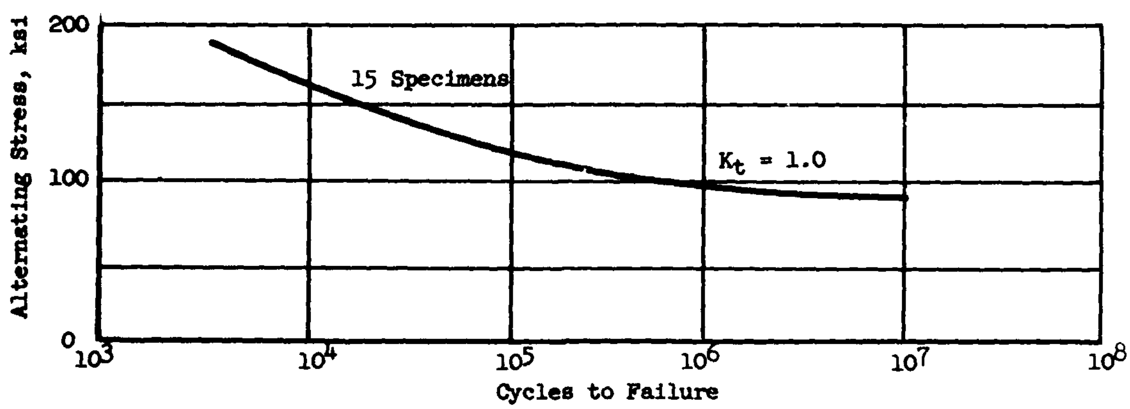

Fig. 19

S-N Curves for Smooth V-Modified 4330 Steel, 236 ksi UTS

(From Ref. 13)

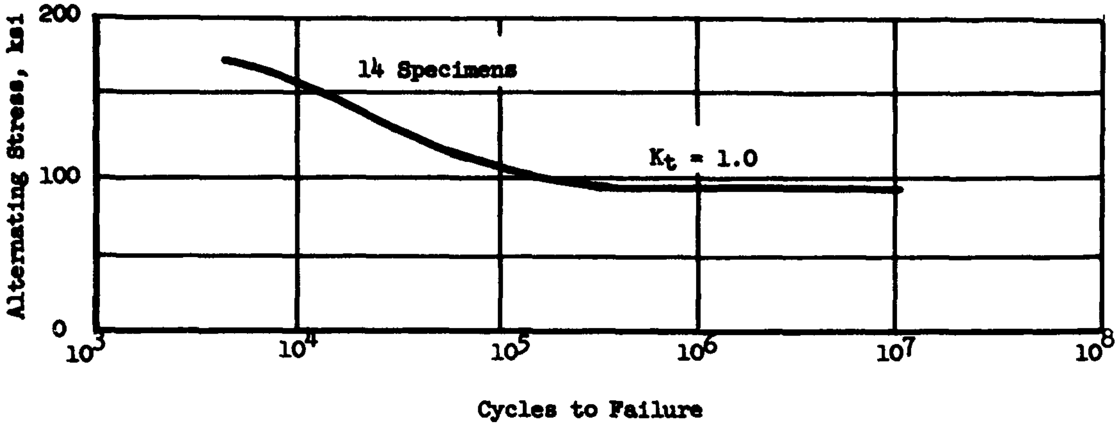

Fig. 20

S-N Curves for Smooth V-Modified 4330 Steel, 222 ksi UTS

(From Ref. 13)

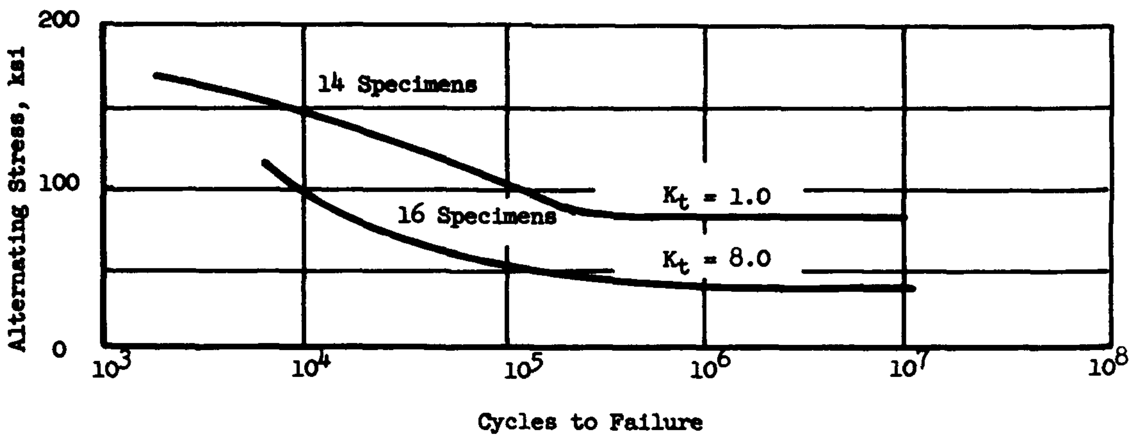

Fig. 21

S-N Curves for V-Modified 4330 Steel, 201 ksi UTS

(From Ref. 13)

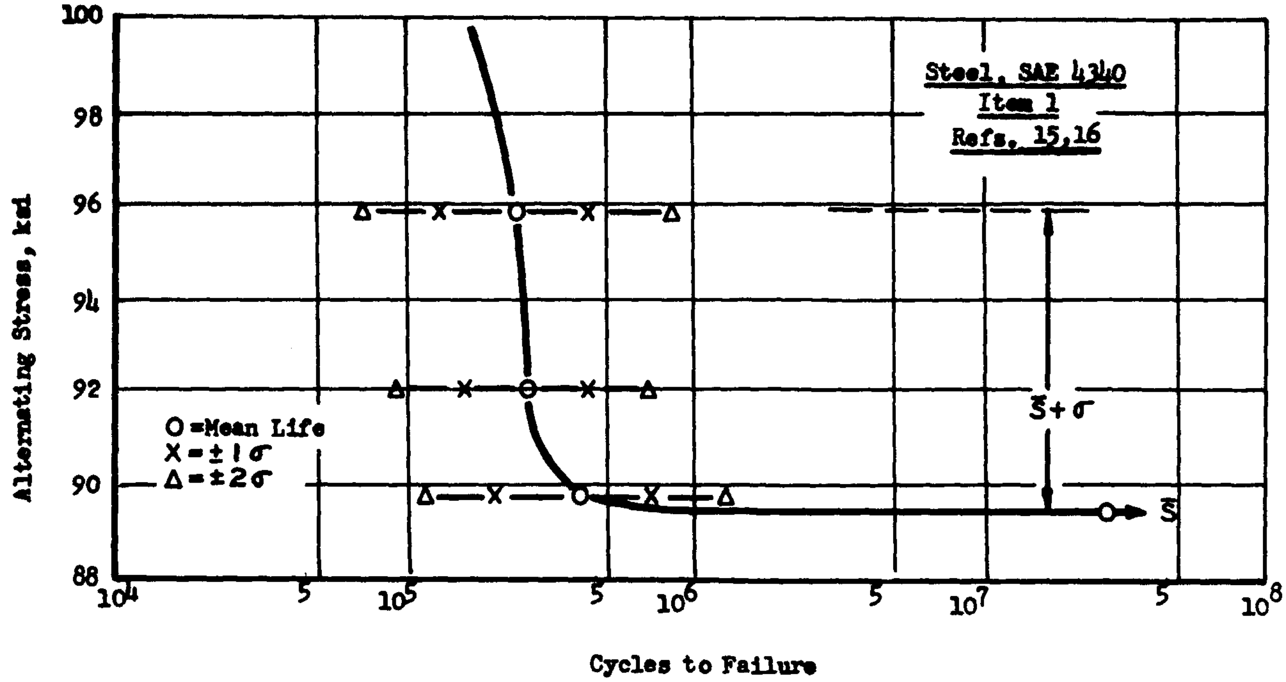

Fig. 22
Statistical Variation in Fatigue Life and Endurance Limit
For Quenched and Tempered SAE 4340

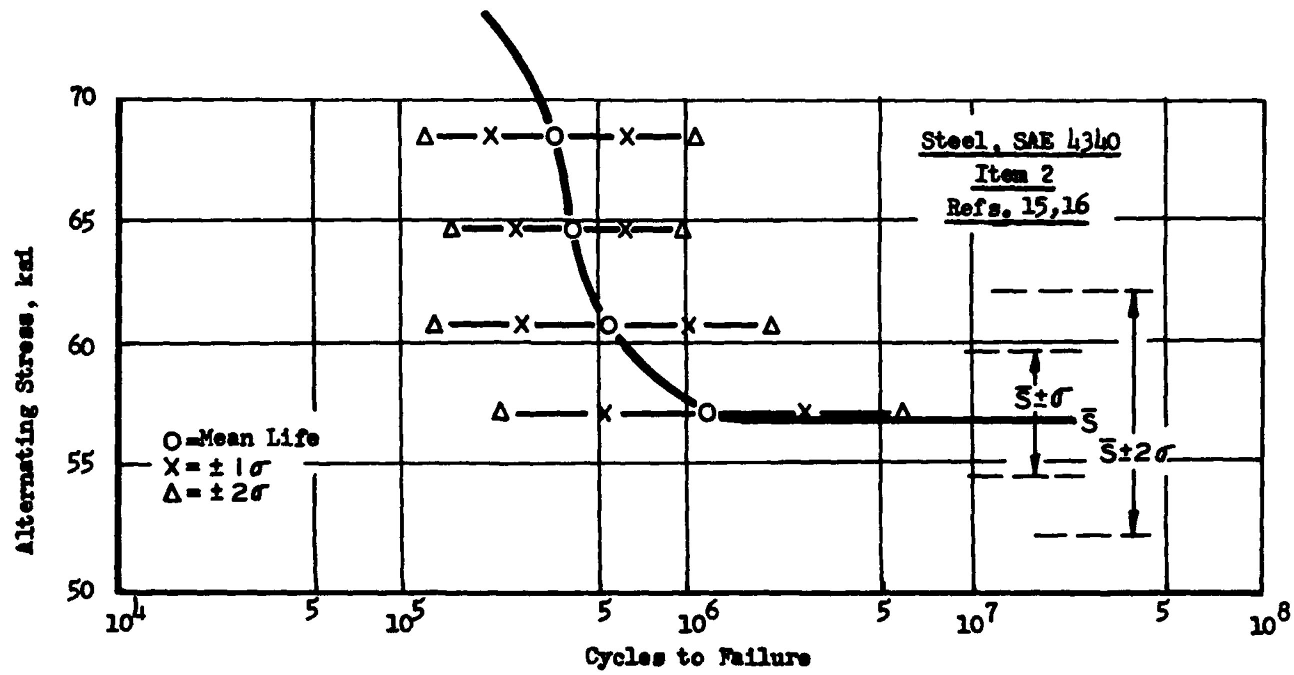

Fig. 23
Statistical Variation in Fatigue Life and Endurance Limit
of Quenched and Spheroidized SAE 4340

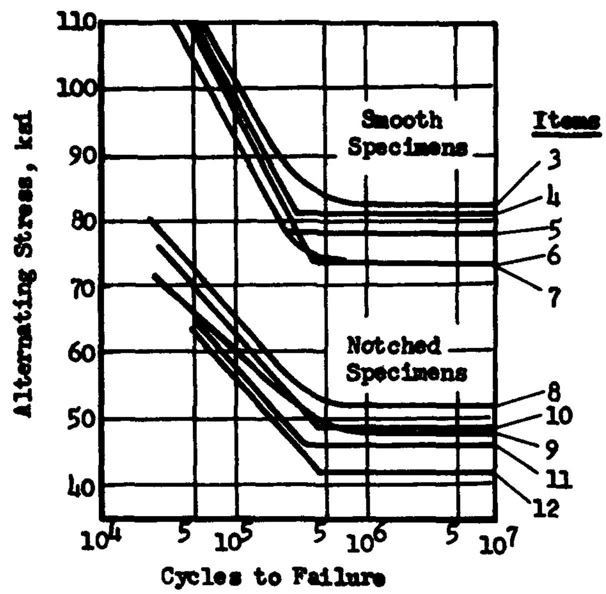

Fig. 24

S-N Curves for SAE 4340 Steel, UTS 164 ksi

(Traced from ref.17)

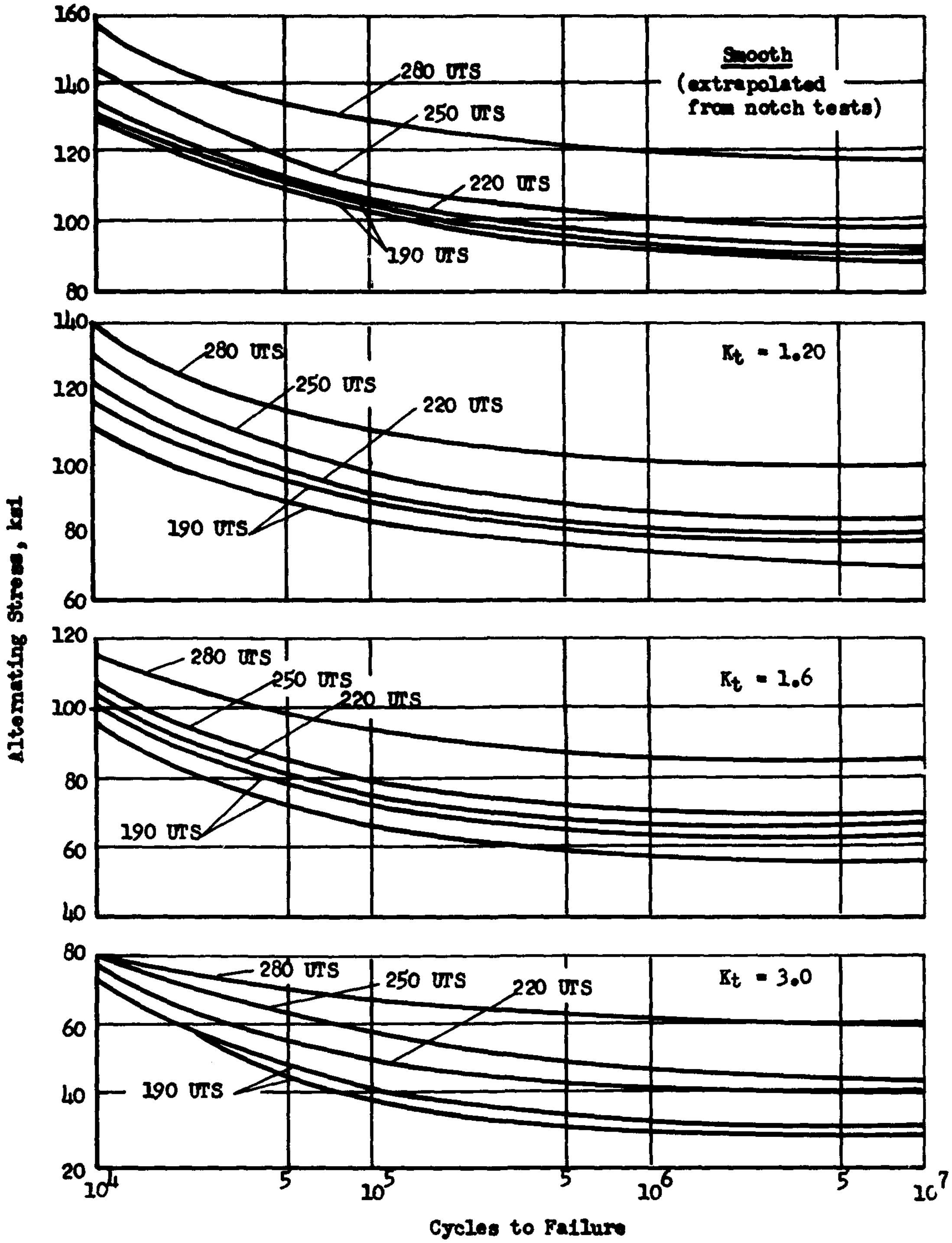

Fig. 25
S-N Curves, for Fully Reversed Axial Stress, of SAE 4340 Steel
(Based on ref. 20)

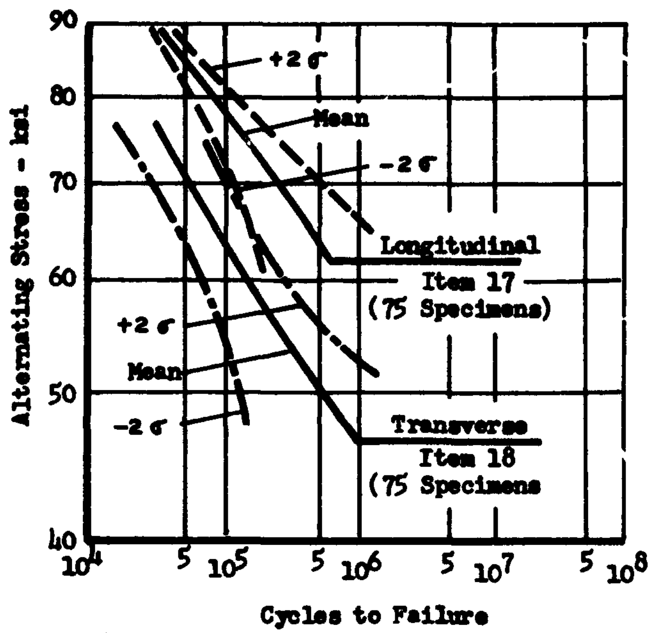

Fig. 26
S-N Curves; SAE 4340 Steel
Low RAT.
(Traced from ref.21)

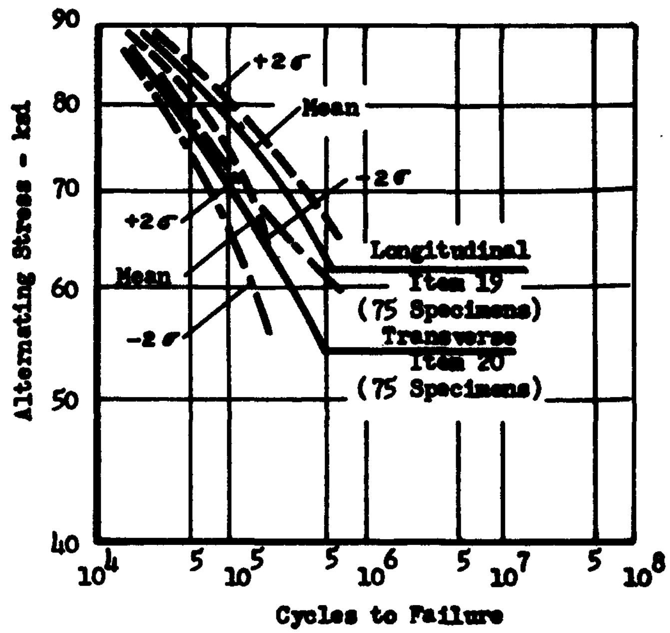

Fig. 27
S-N Curves; SAE 4340 Steel
High RAT.
(Traced from ref.21)

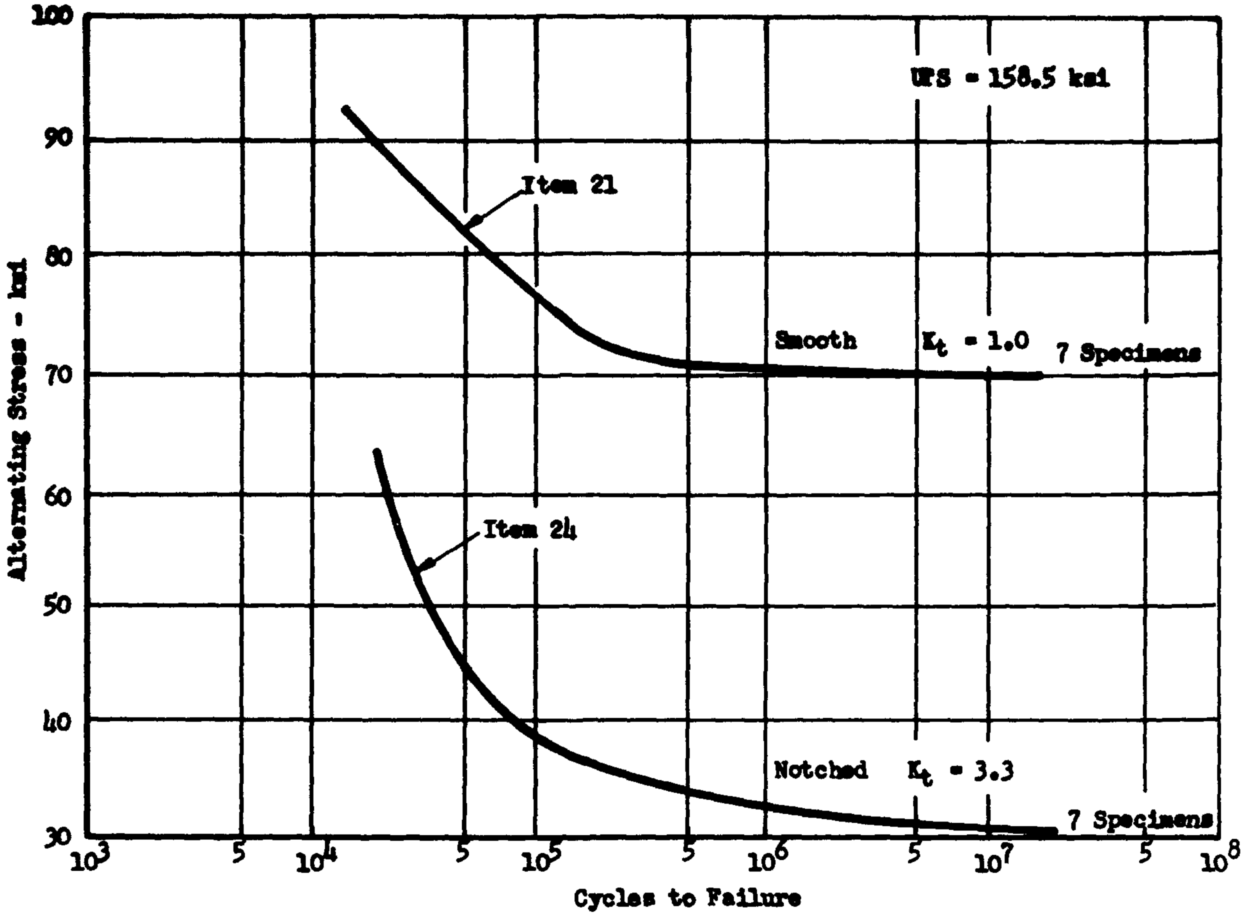

Fig. 28

"Fully Reversed" S-N Curves for SAE 4340 Steel - Room Temp.

(Traced from ref. 22)

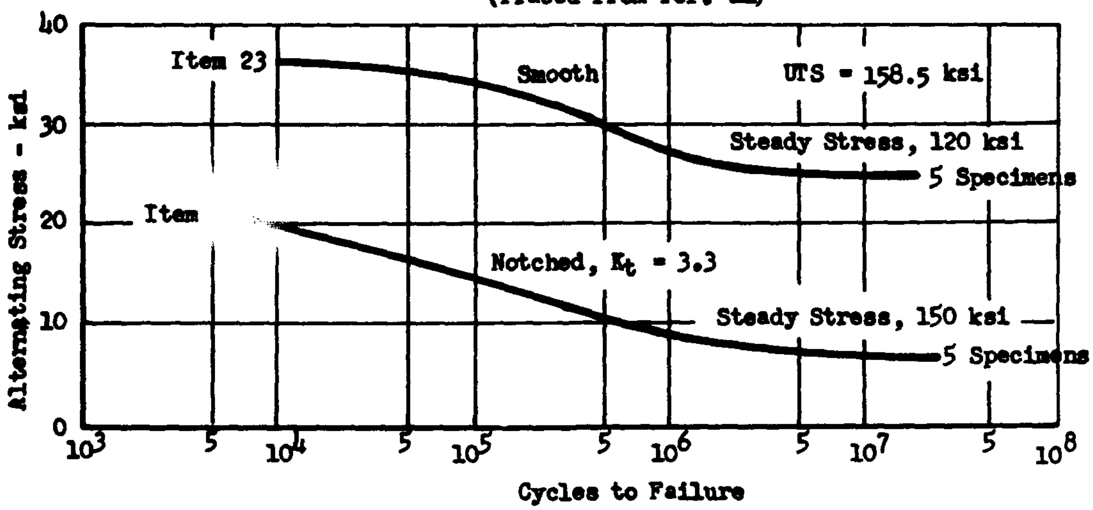

Fig. 29

S-N Curves for SAE 4340 Steel - Room Temp. - With Steady Stress

(From ref. 22)

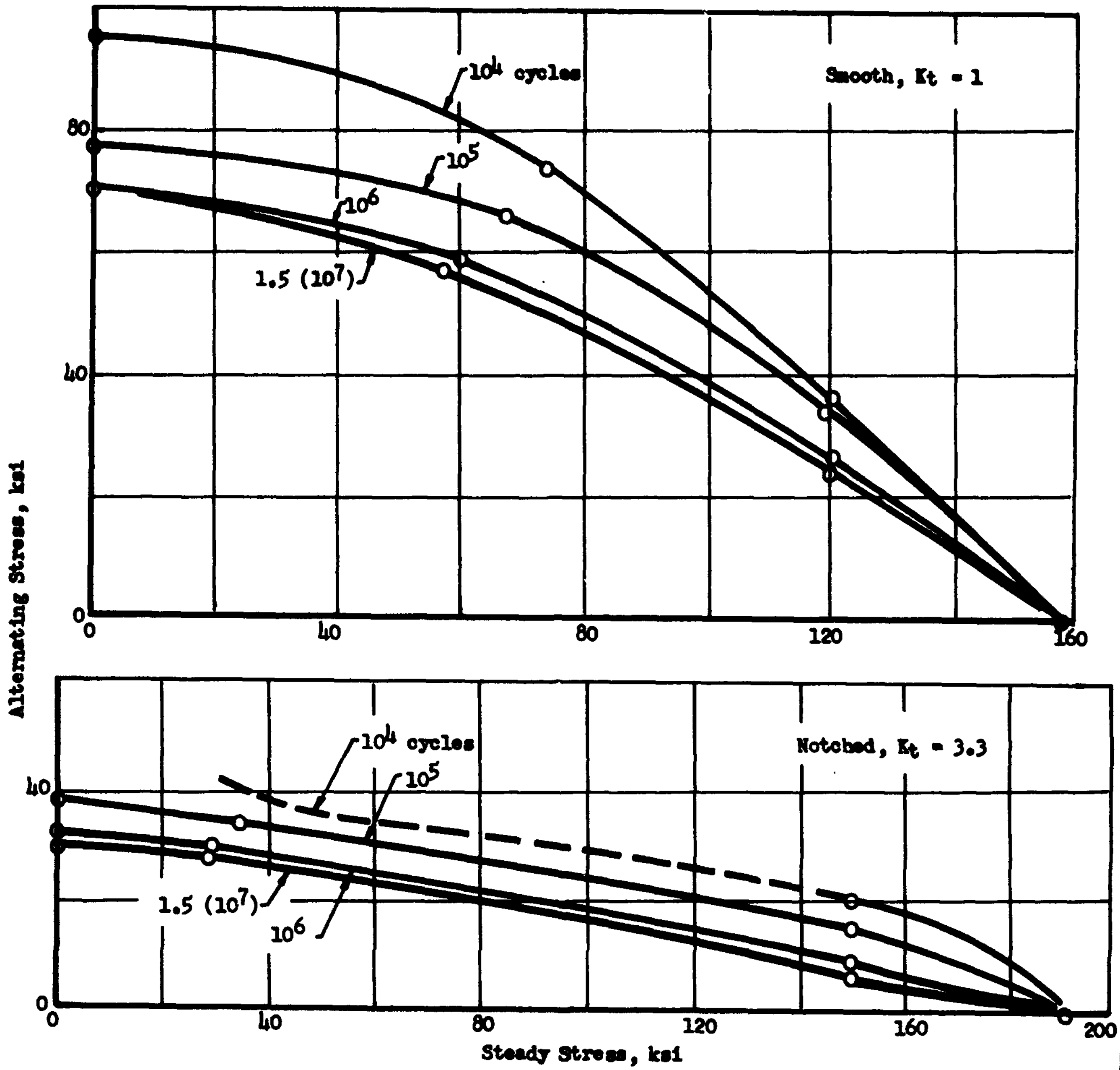

Fig. 30

Alternating Stress - Steady Stress Diagrams for Different Lifetimes. SAE 4340 Steel, of 158.5 ksi UTS

Axial Tests

(Traced from ref. 32)

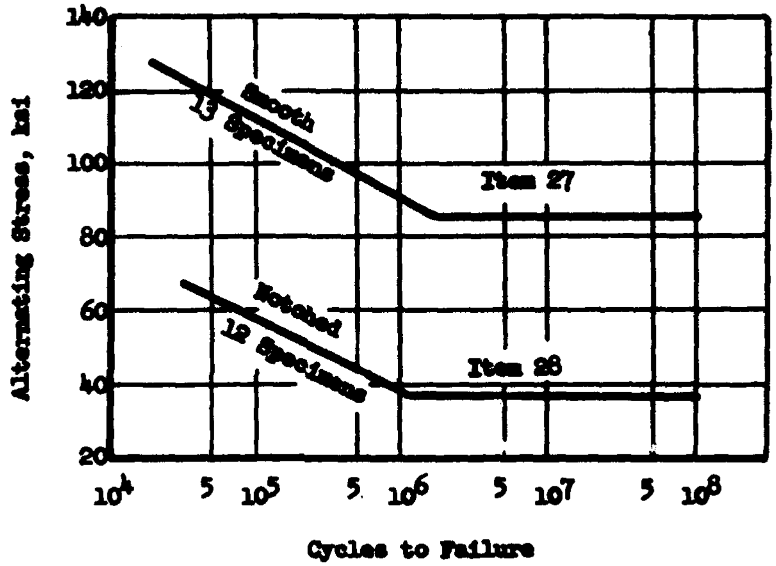

Fig. 31

S-N Curves for SAE 4340 Steel, UTS 150 ksi

(Traced From Ref. 23)

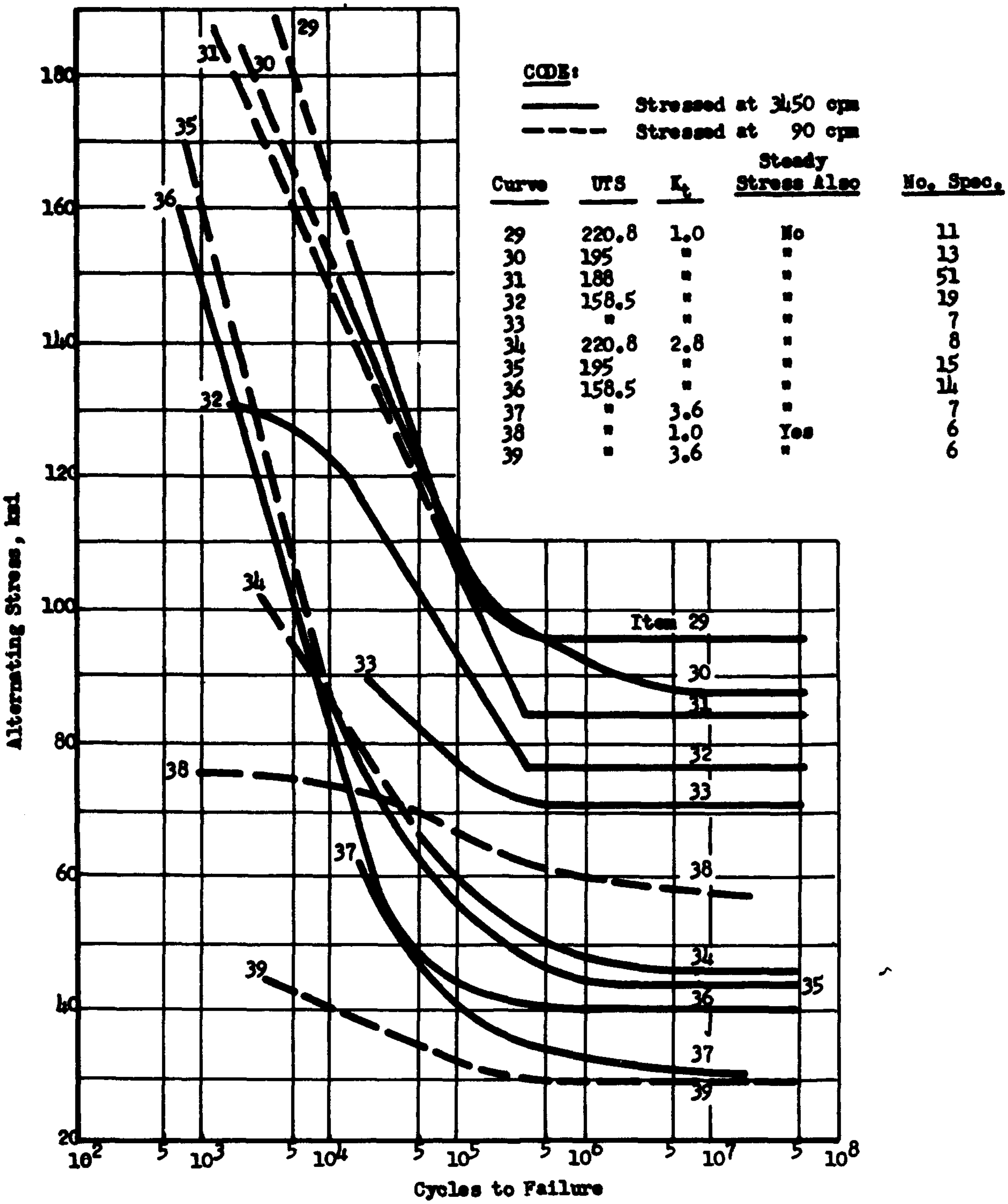

Fig. 32

S-N Curves for SAE 4340 Steel

(Plotted from scaled readings on charts in ref. 24)

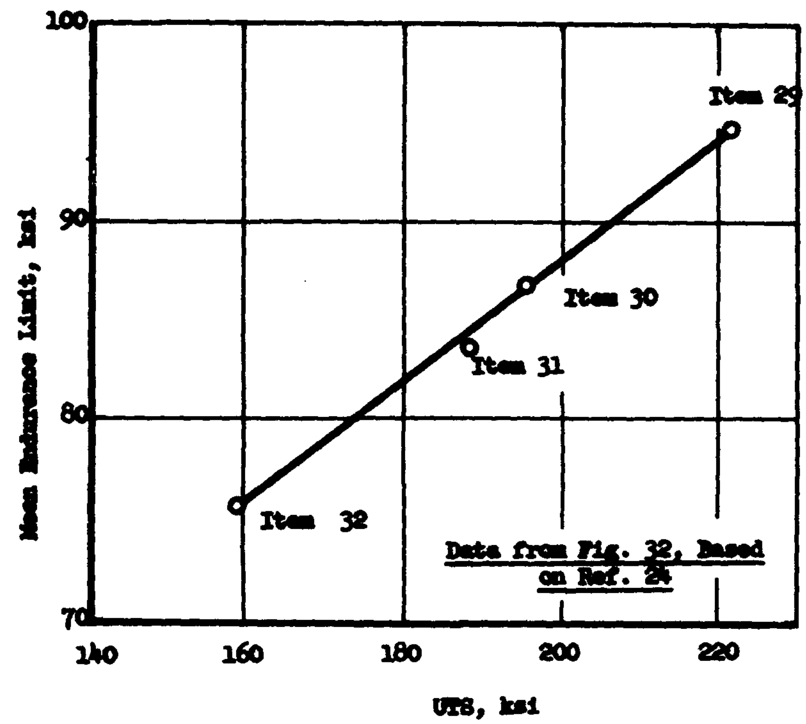

Fig. 33

Mean Endurance Limit vs. UTS of SAE 4340 Steel

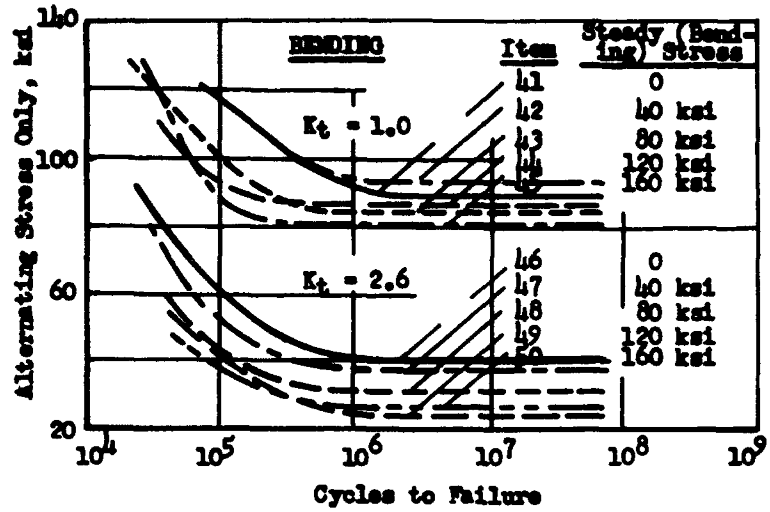

Fig. 34

S-N Curves for SAE 4340 Steel, 172 ksi UTS Tested in Bending

(Some Stresses have been corrected for yielding)
(Traced from ref. 26)

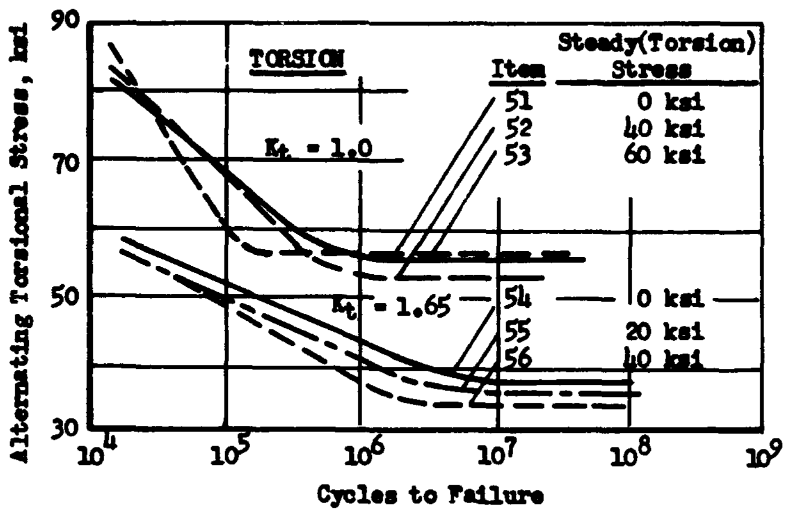

Fig. 35

S-N Curves for SAE 4340 Steel, 172 ksi UTS Tested in Torsion

(Some Stresses have been corrected for yielding)
(Traced from ref. 26)

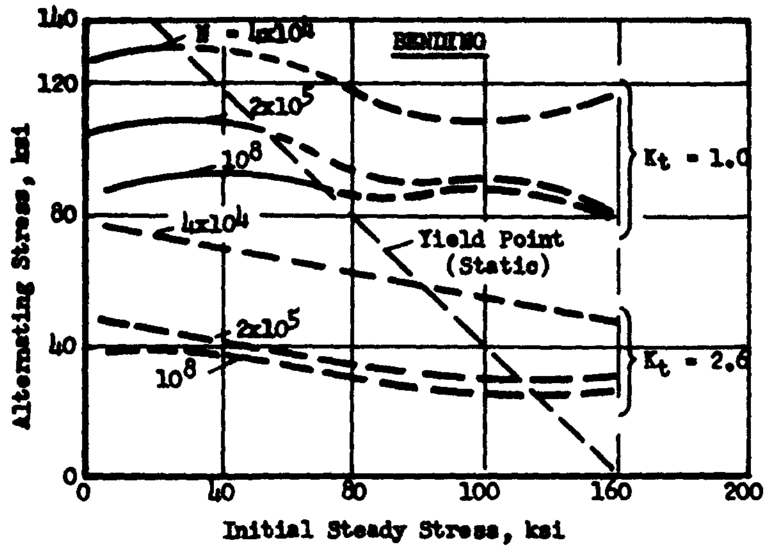

Fig. 36

Alternating vs. Steady Bending Stresses for SAE 4340 Steel, 172 ksi UTS

(Traced from ref. 26)

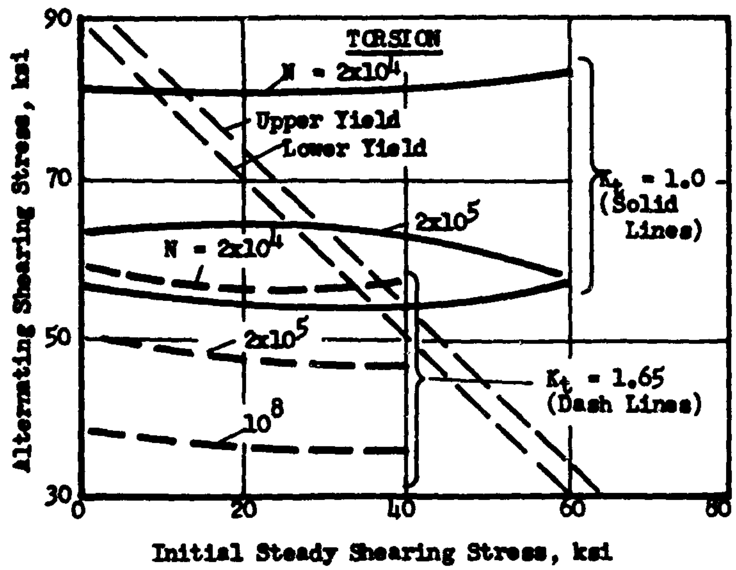

Fig. 37

Alternating vs. Steady Shearing (Torsion) Stresses, for SAE 4340 Steel, 172 ksi UTS

(Traced from ref. 26)

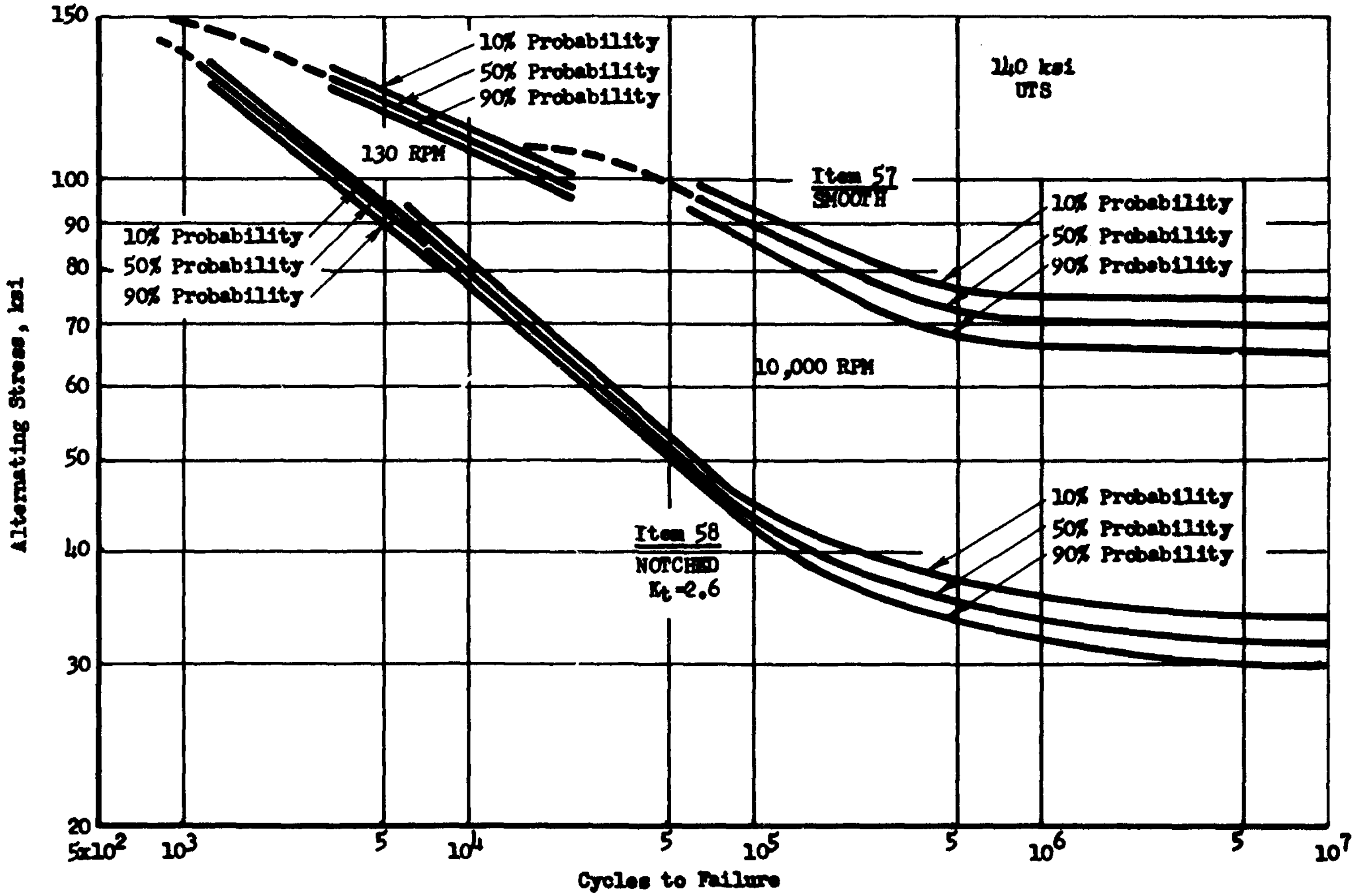

Fig. 38

S-N Curves of Constant Probability of Survival of Stress at Constant Life, For SAE 4340 Steel, 140 ksi UTS. R. R. Moore Rotating Beam Tests.

(From ref. 27)

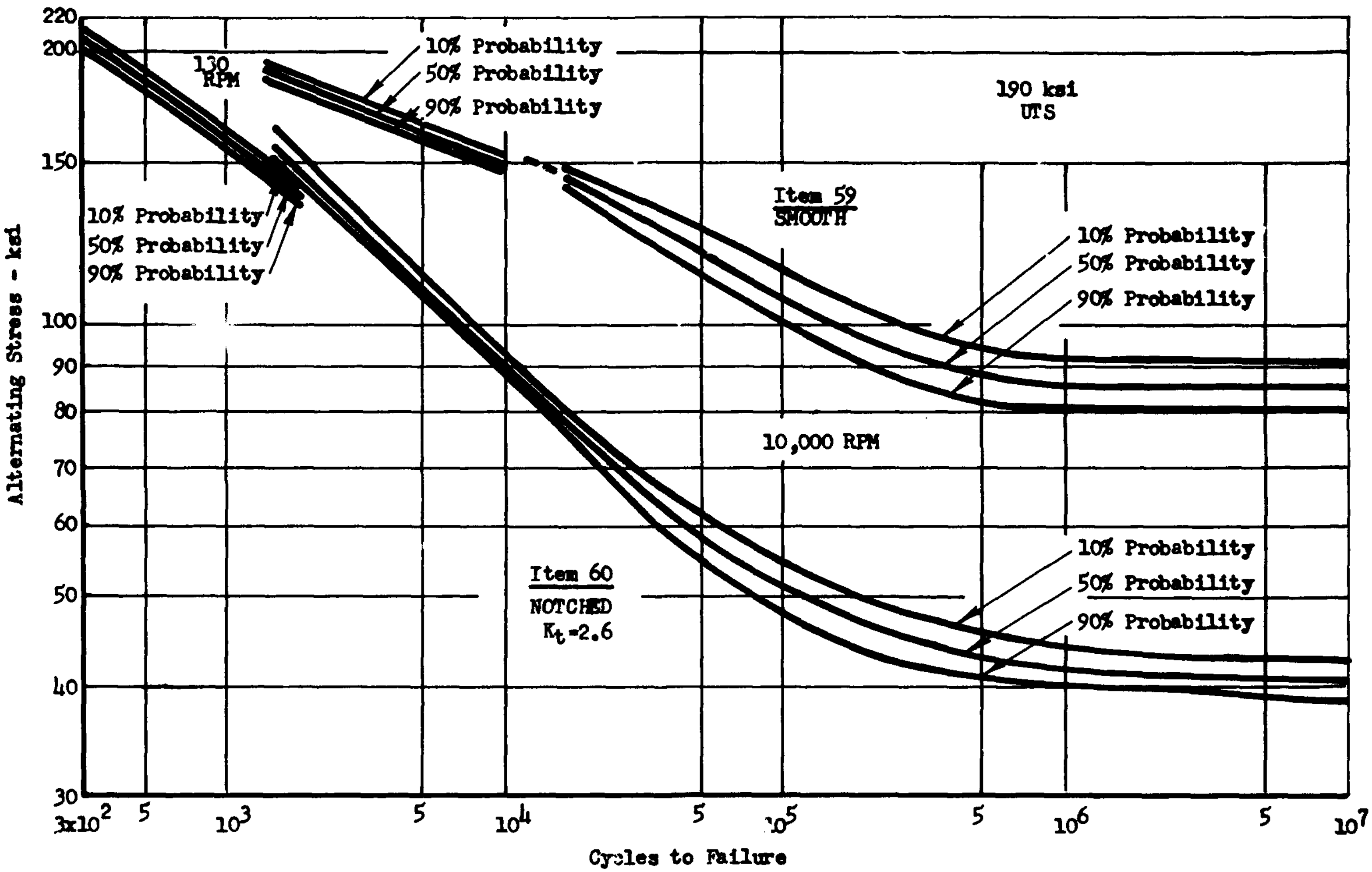

Fig. 39

S-N Curves of Constant Probability of Survival of Stress at Constant Life, For SAE 4340 Steel, 190 ksi UTS. R. R. Moore Rotating Beam Tests.

(From ref. 27)

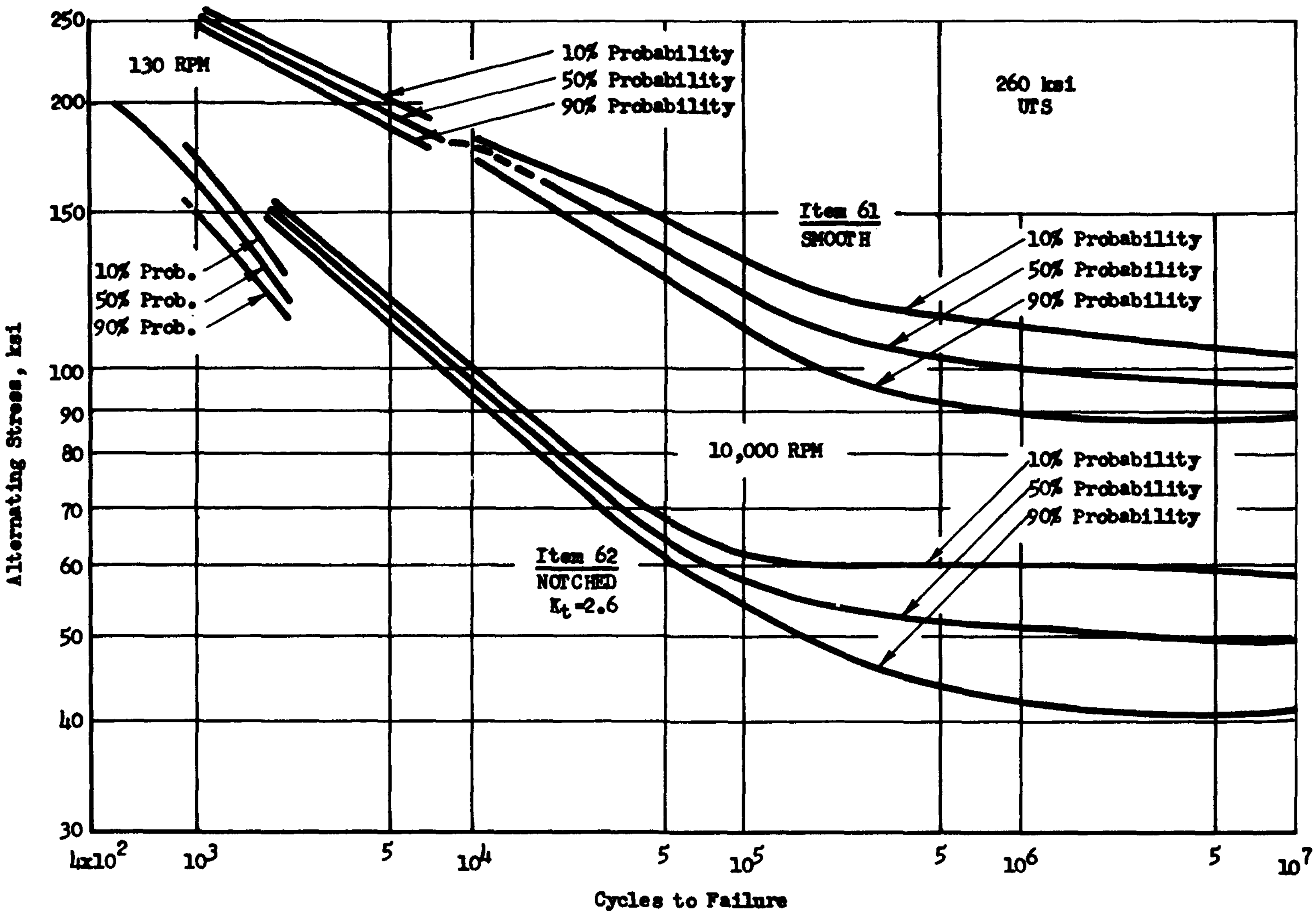

Fig. 40

S-N Curves of Constant Probability of Survival of Stress at Constant Life, For SAE 4340 Steel, 260 ksi UTS. R. R. Moore Rotating Beam Tests.

(From ref. 27)

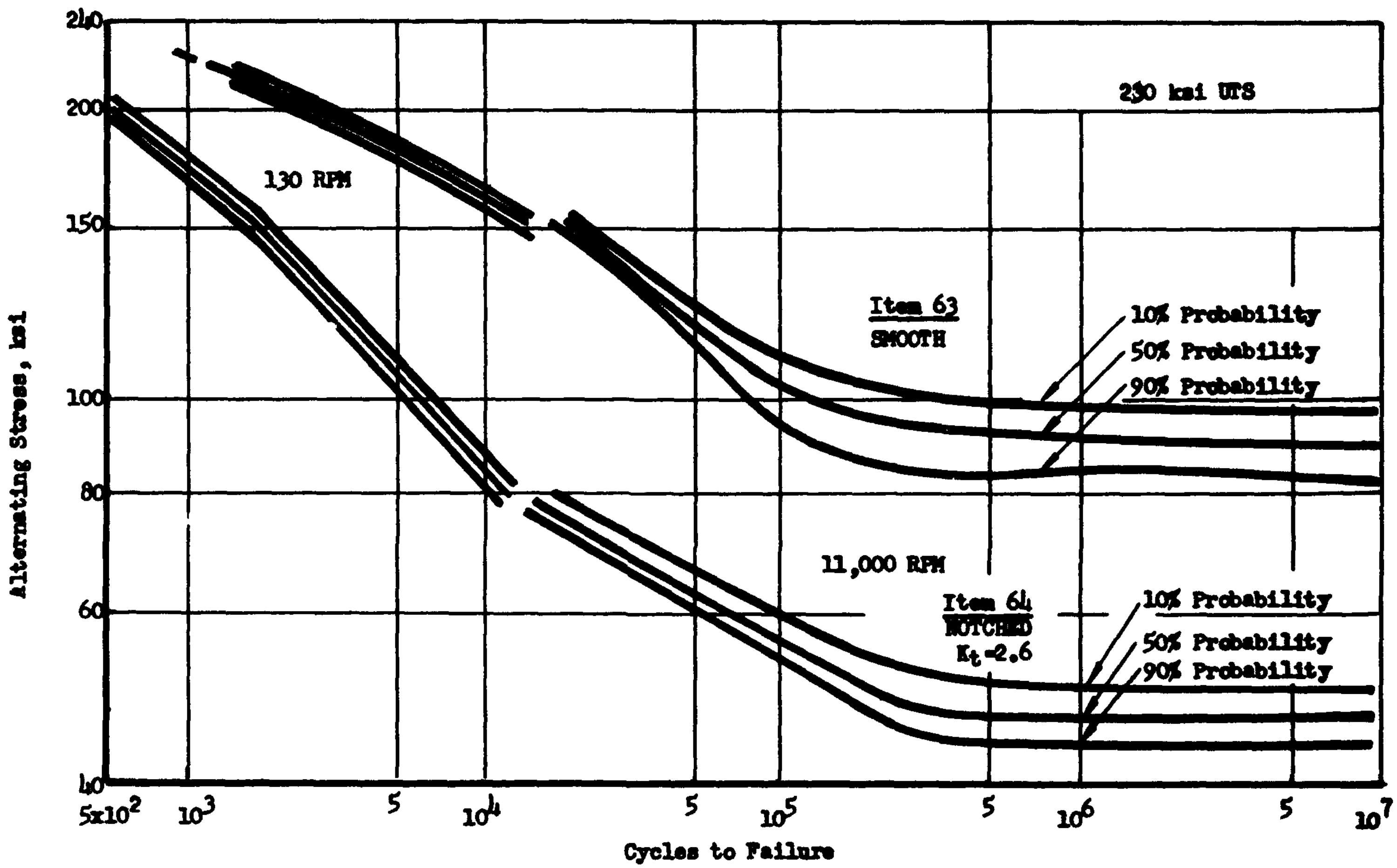

Fig. 41

S-N Curves of Constant Probability of Survival of Stress at Constant Life, For SAE 4340 Steel, 230 ksi UTS. R. R. Moore Rotating Beam Tests.

(From ref. 29)

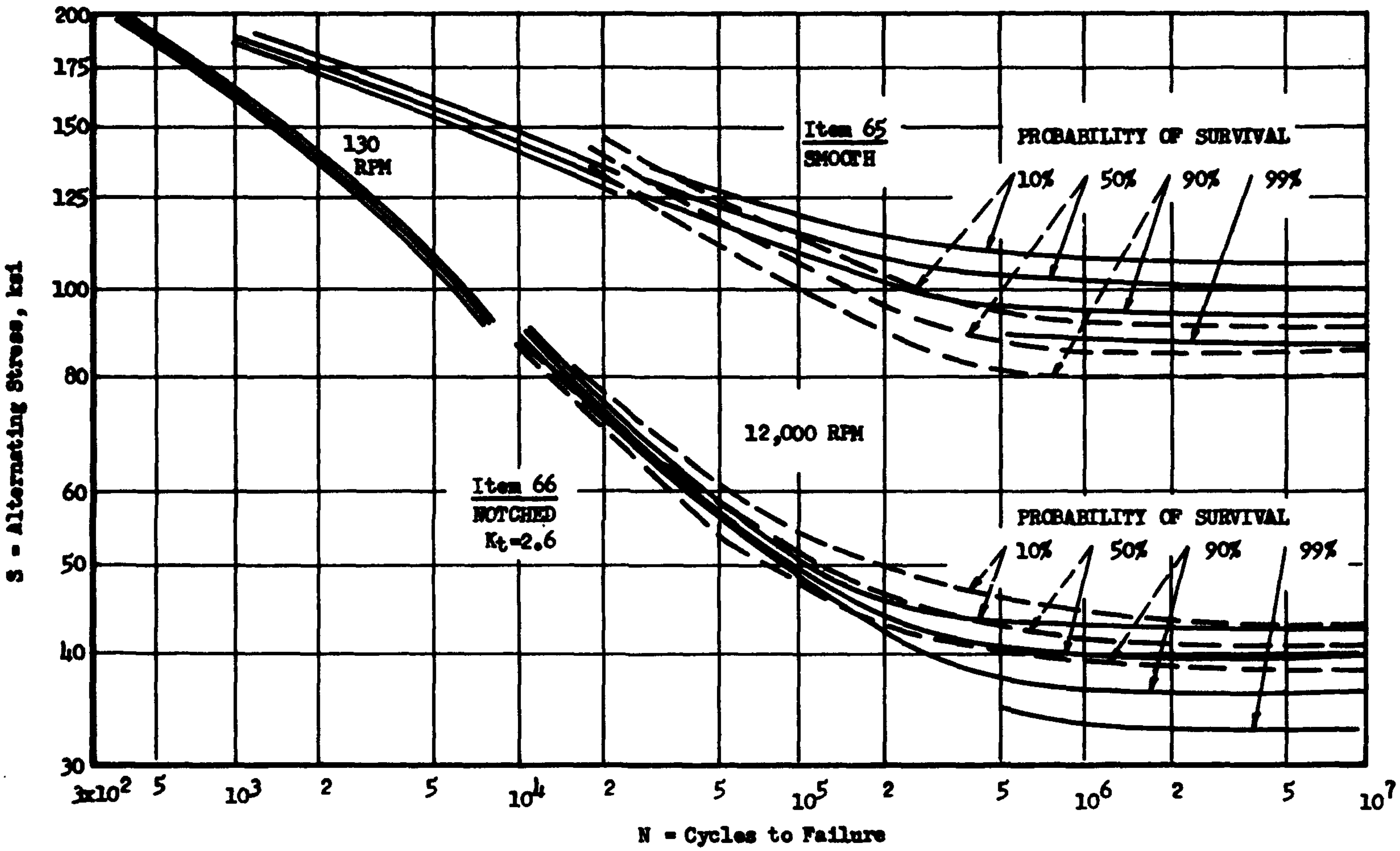

Fig. 42

S-N Curves of Constant Probability of Survival of Stress at Constant Life

Heavy Solid Line,-Vacuum Melted SAE 4340 Steel, 190 ksi UTS

Light Dash Line,-Aircraft Quality SAE 4340 Steel, 190 ksi UTS

(From ref. 29)

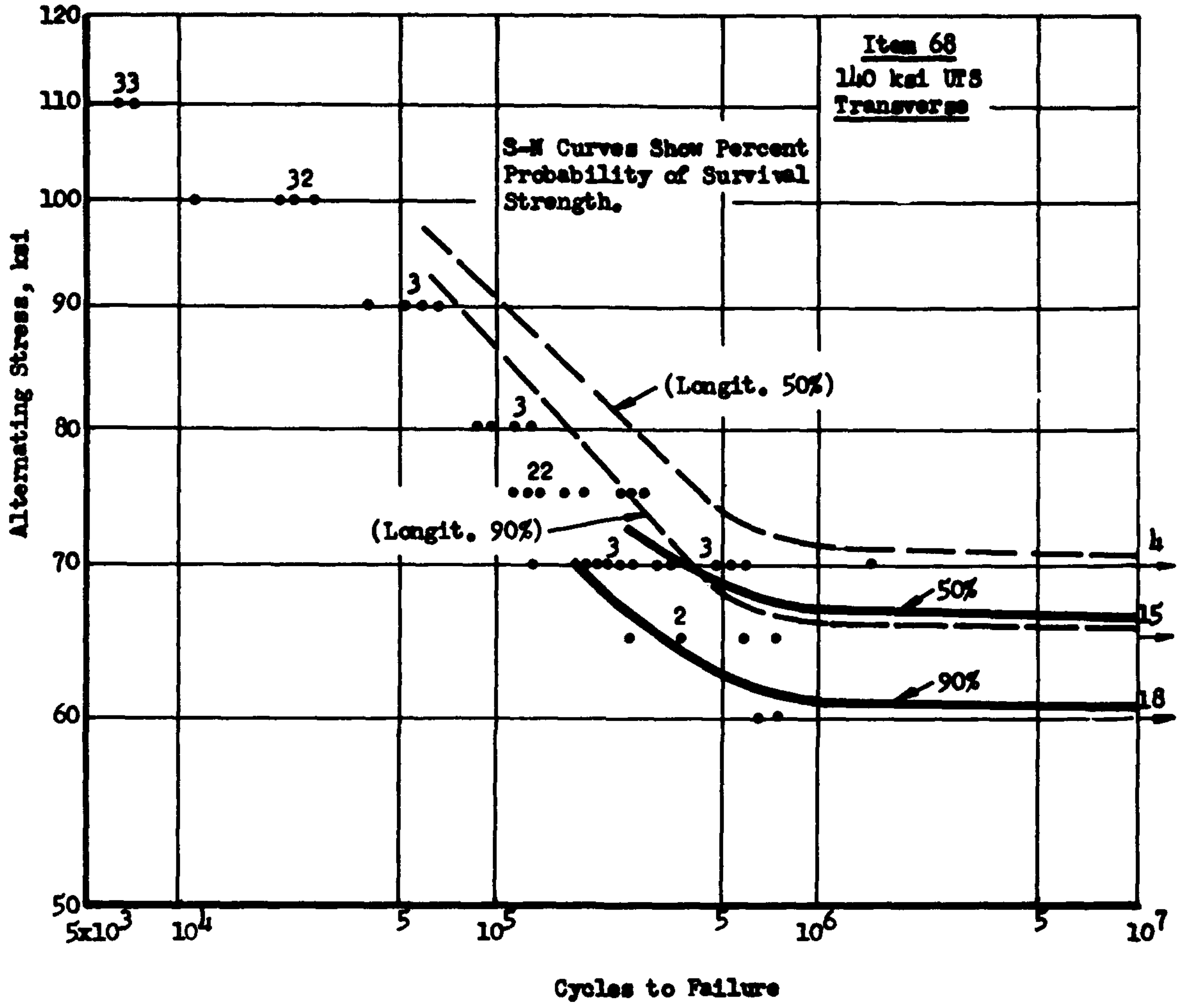

Fig. 43

Tests of SAE 4340 Steel, UTS 140 ksi

Transverse Smooth Specimens

R. R. Moore Rotating Bending Tests

(From ref. 30)

(Light dash lines show longitudinal values)

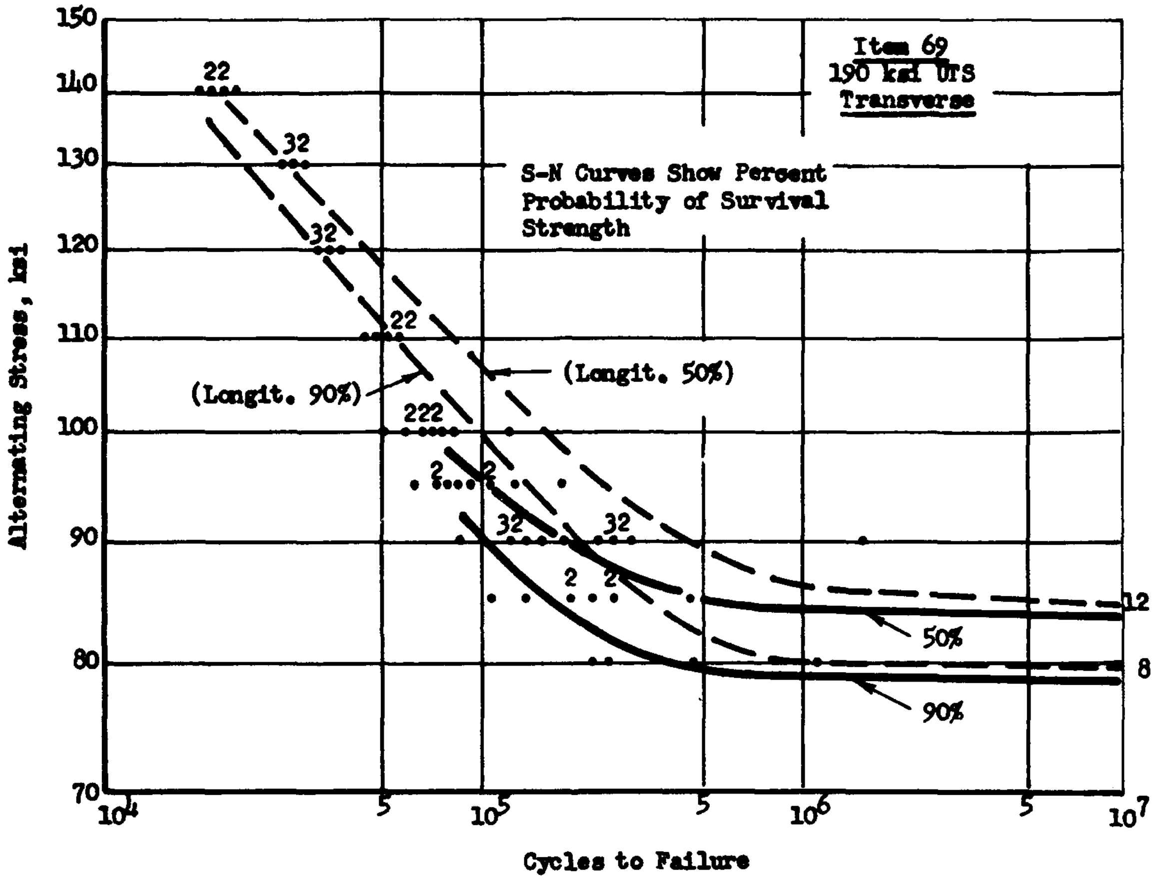

Fig. 44

Tests of SAE 4340 Steel, UTS 190 ksi

Transverse Smooth Specimens

R. R. Moore Rotating Bending Tests

(From ref. 30)

(Light dash lines show longitudinal values)

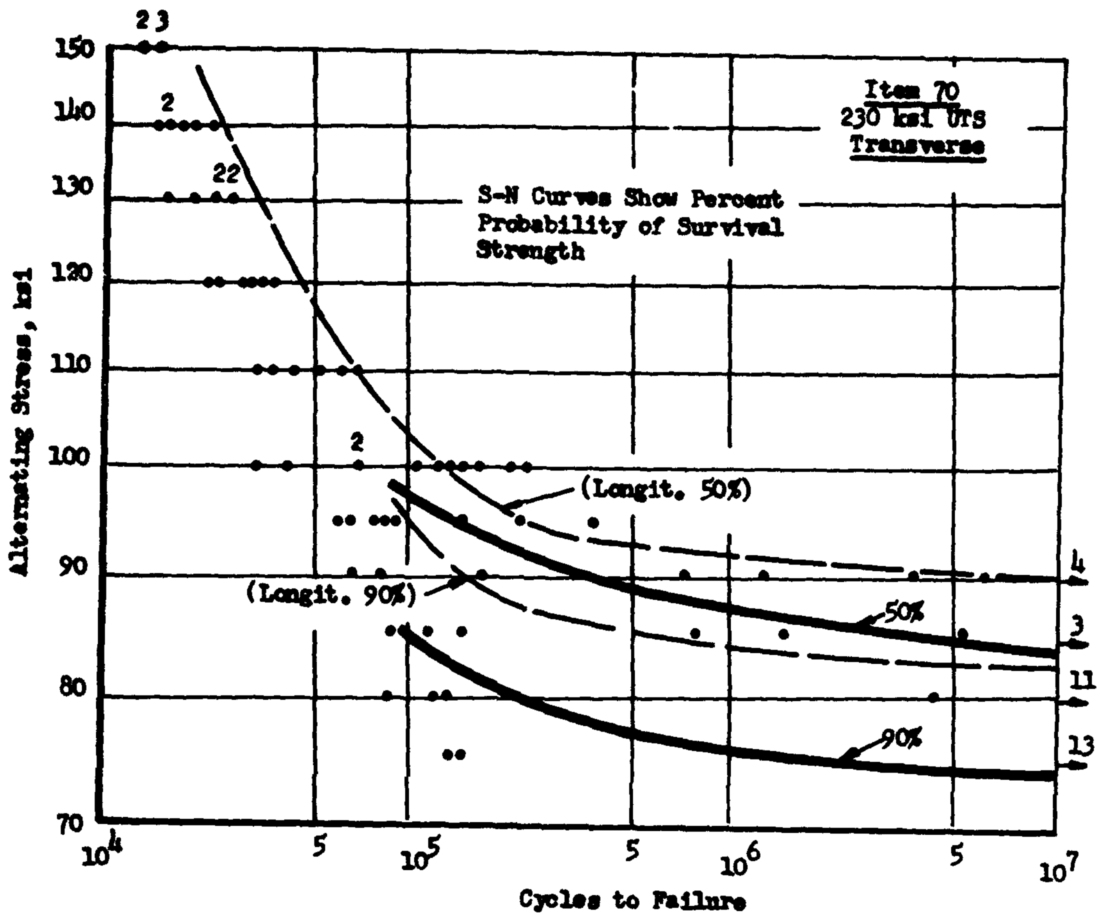

Fig. 45

Tests of SAE 4340 Steel, UTS 230 ksi

Transverse Smooth Specimens

R. R. Moore Rotating Bending Tests

(From ref. 30)

(Light dash lines show longitudinal values)

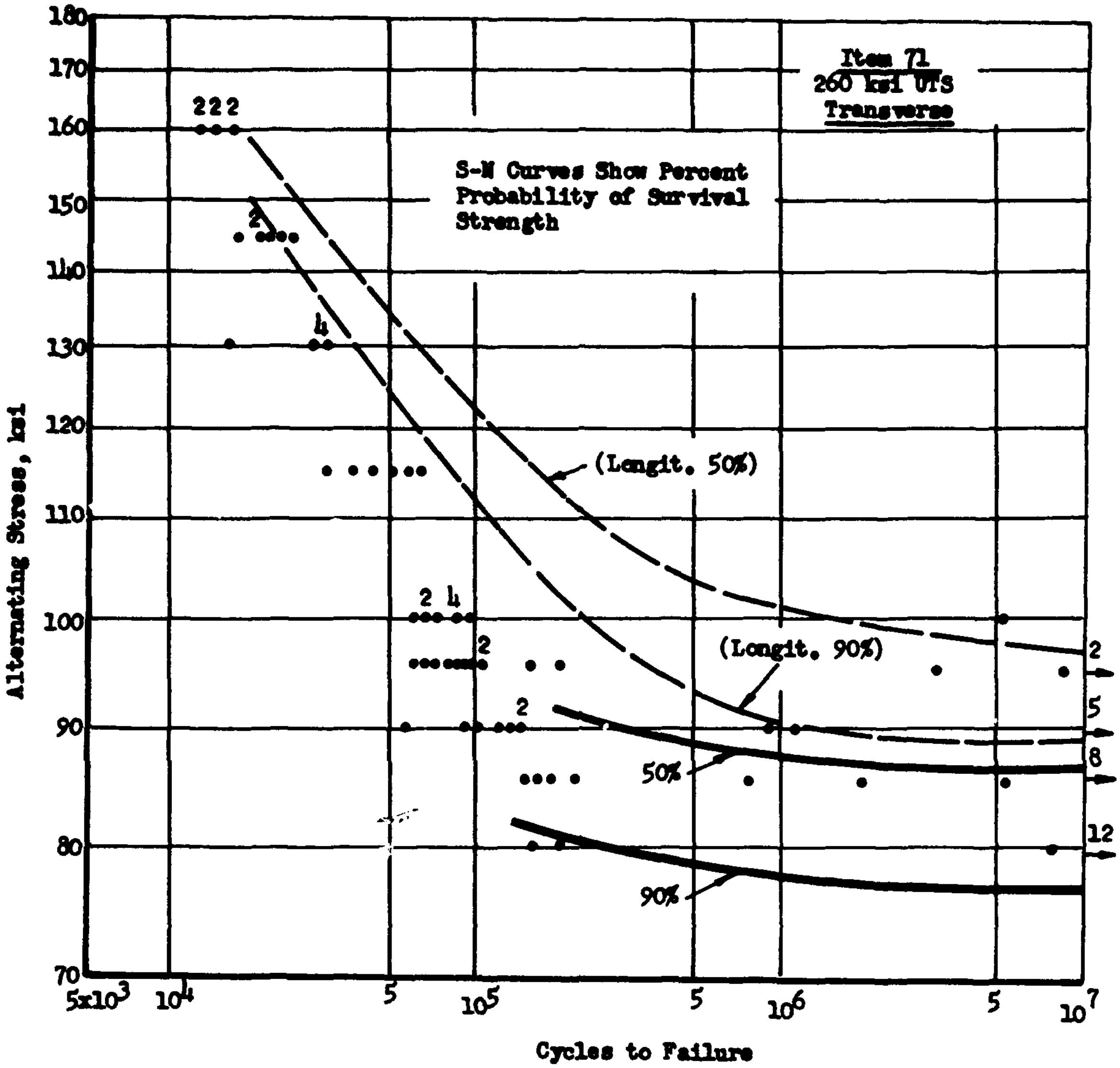

Fig. 46

Tests of SAE 4340 Steel, UTS 260 ksi

Transverse Smooth Specimens

R. R. Moore Rotating Beam Tests

(From ref. 30)

(Light dash lines show longitudinal values)

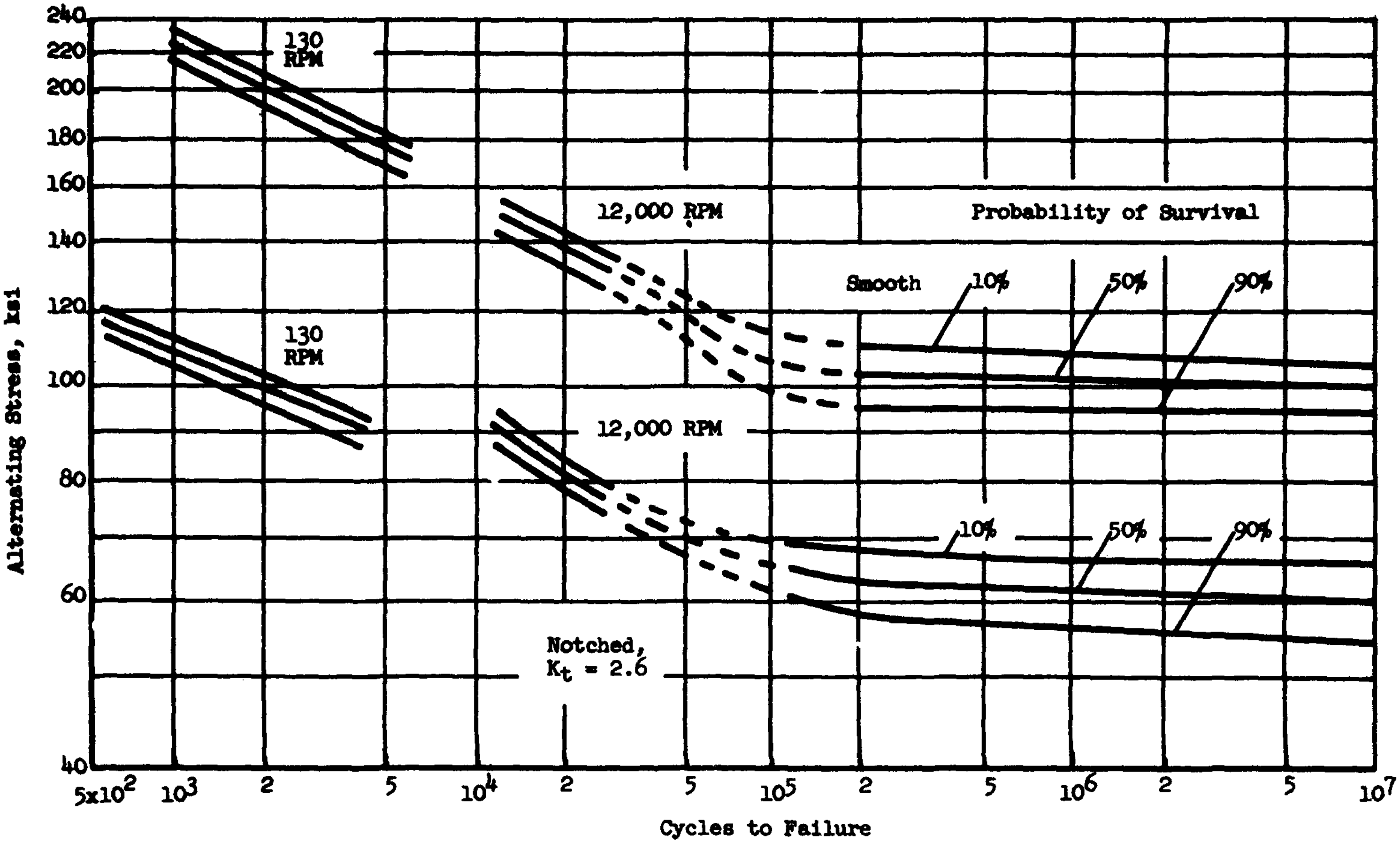

Fig. 47

S-N Curves of Constant Probability of Survival of Stress at Constant Life R. R. Moore Rotating Beam Tests of 4350 Steel, 300 ksi UTS

(Dash lines connect curves whose position was computed.)

(From Ref. 29)

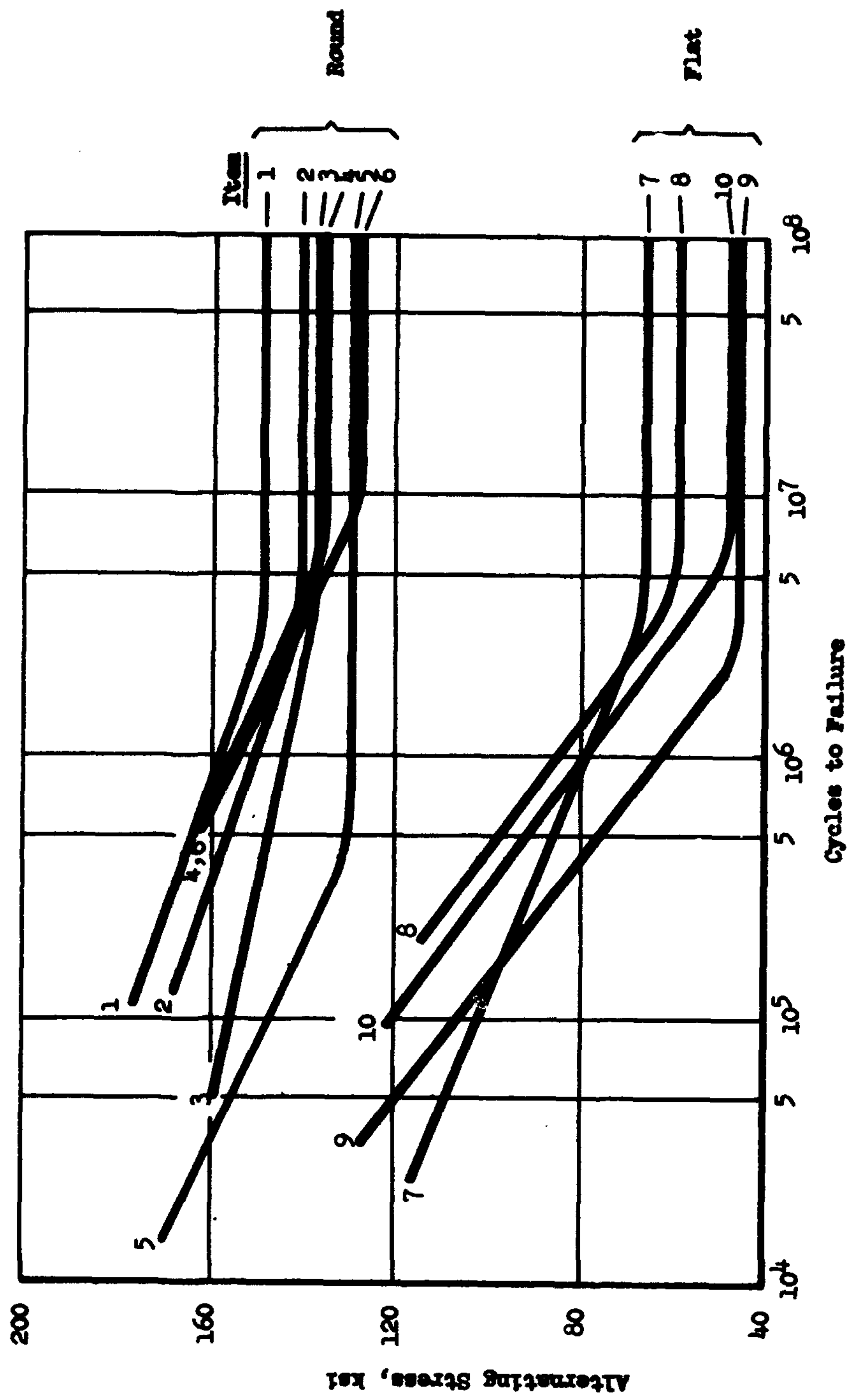

Fig. 48

S-N Curves for 52100 Steel, R_c = 59

(Based on Ref. 32)

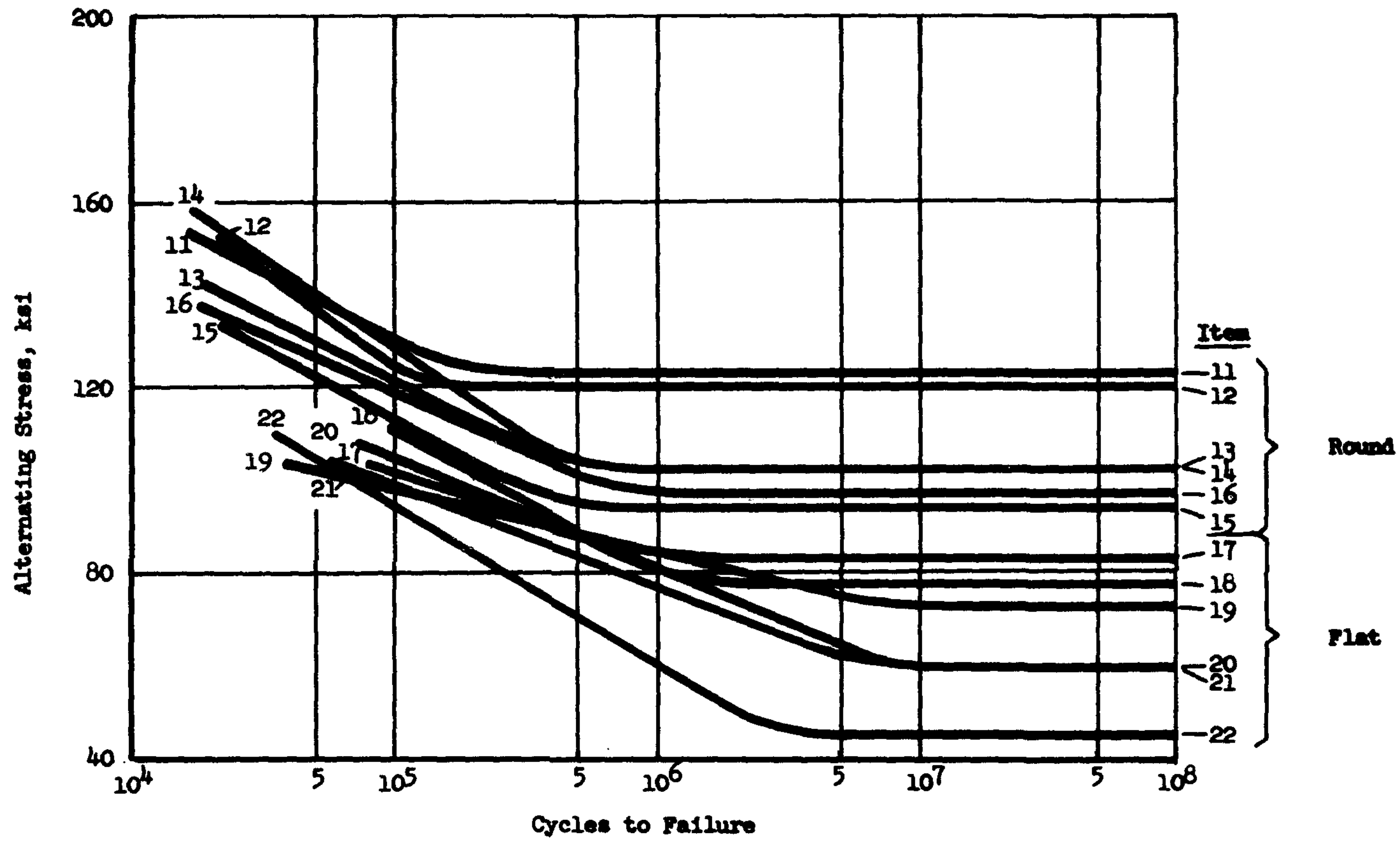

Fig. 49

S-N Curves for 52100 Steel, $R_c = 45$

(Based on Ref. 32)

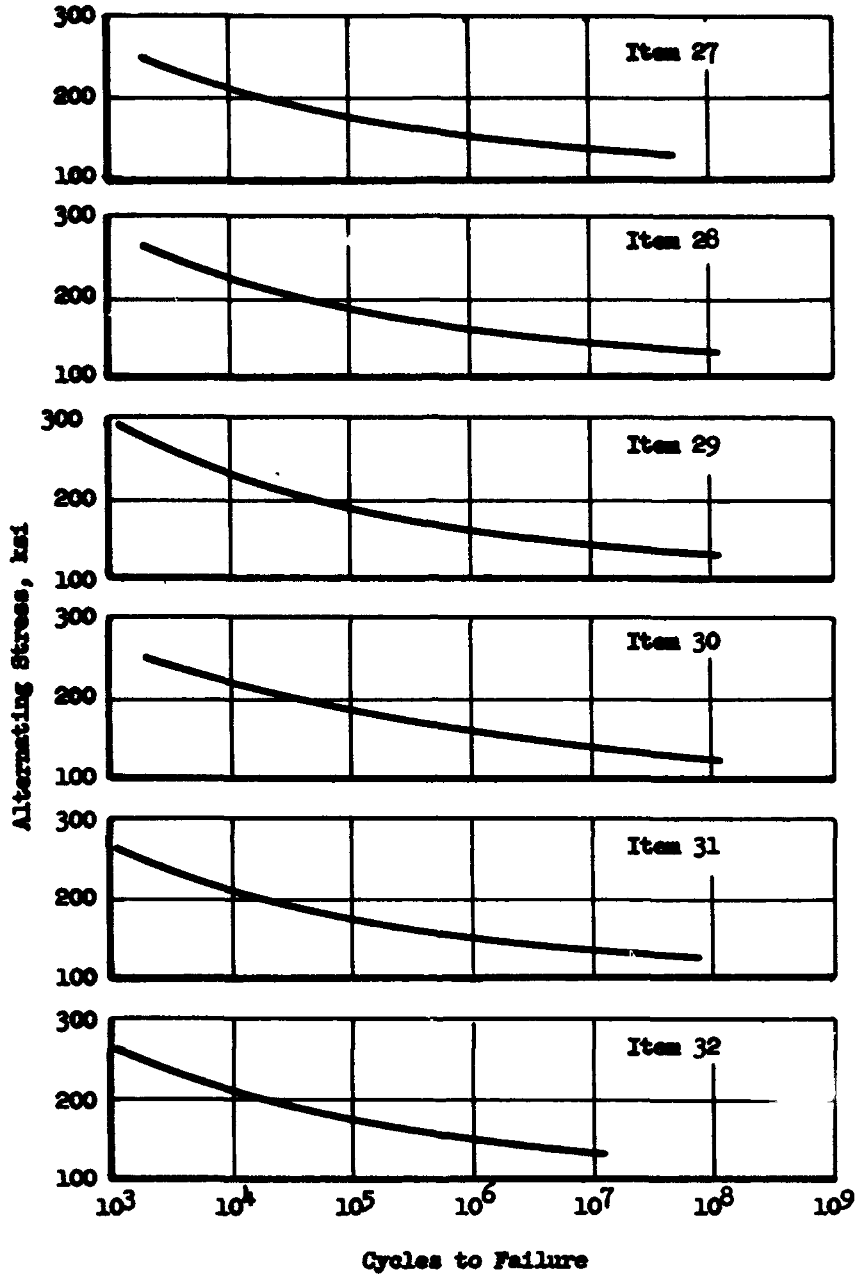

Fig. 50

S-N Curves - 52100 Steel, Rotating Beam Specimens

(Based on Ref. 33)

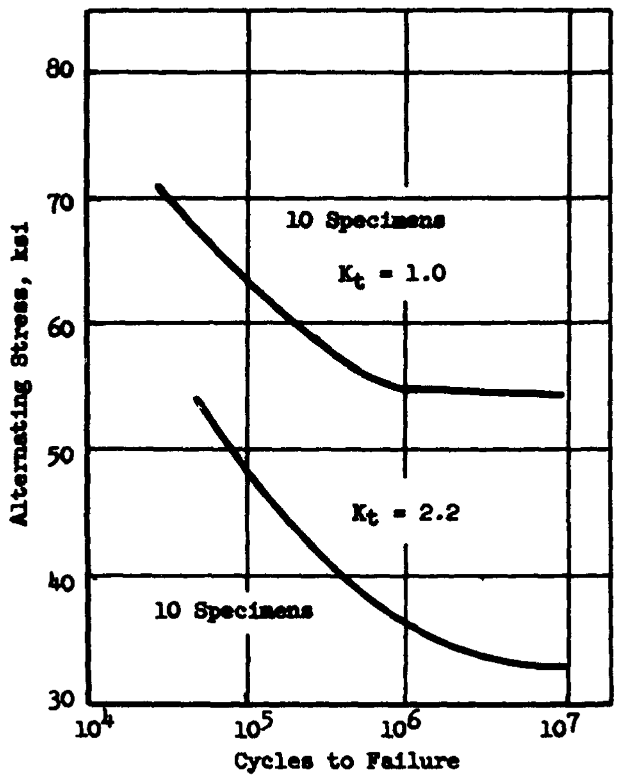

Fig. 51
S-N Curves for 8630 Cast Steel,
Normalized and Tempered,
110.5 ksi UTS
(From ref. 5)

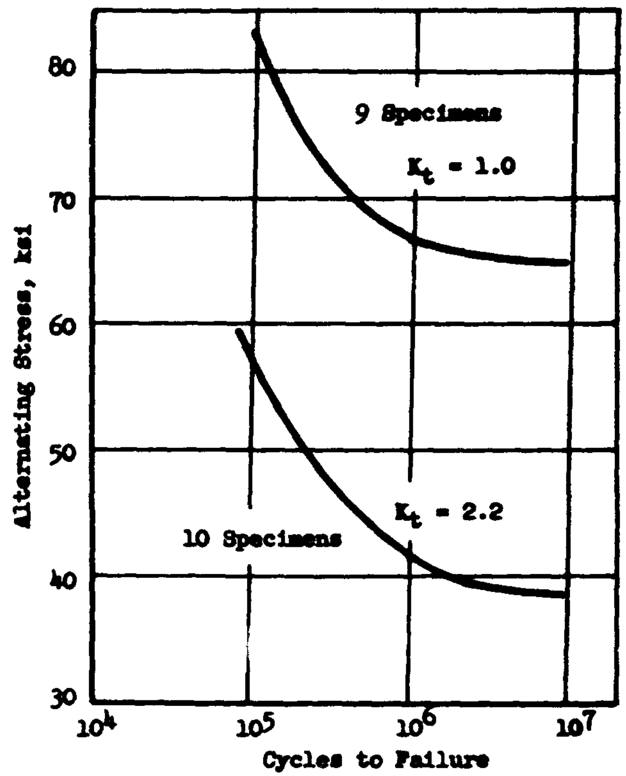

Fig. 52
S-N Curves for 8630 Cast Steel,
Quenched and Tempered,
137.5 ksi UTS
(From ref. 5)

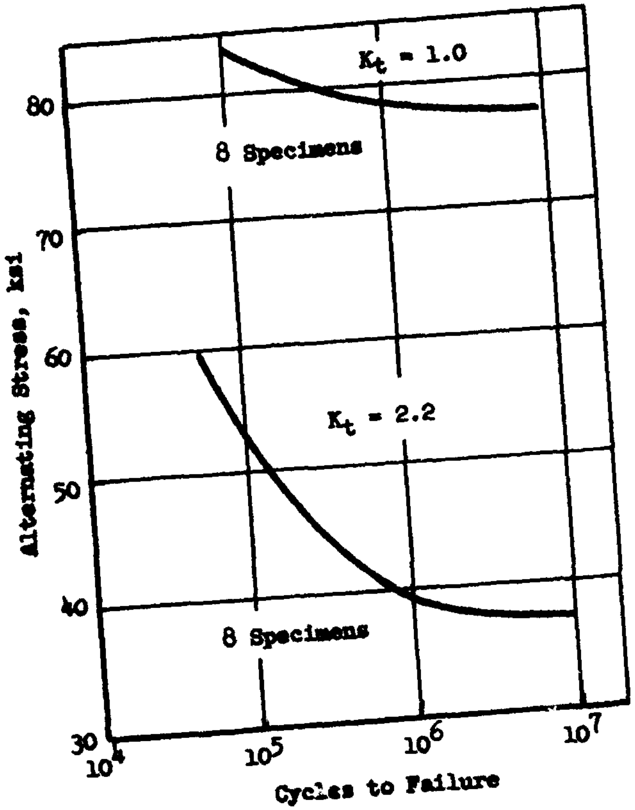

Fig. 53

S-N Curves for 8640 Wrought Steel,
Quenched and Tempered,
138 ksi UTS

(From ref. 5)

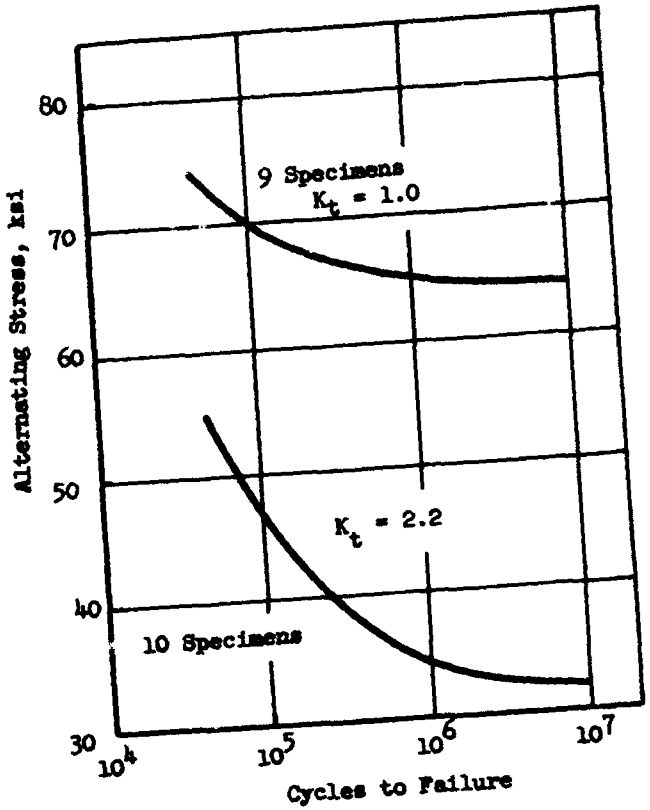

Fig. 54

S-N Curves for 8640 Wrought Steel,
Normalized and Tempered,
108.5 ksi UTS

(From ref. 5)

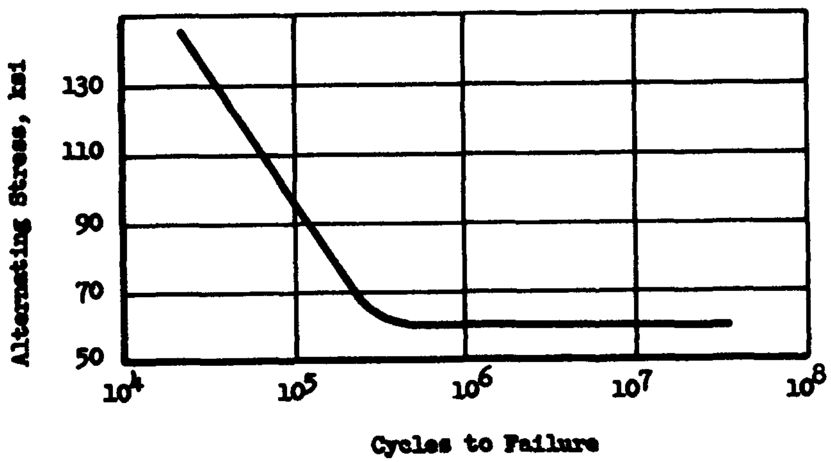

Fig. 55

S-N Curve for 14B50 Steel, Smooth

(From Ref. 8)

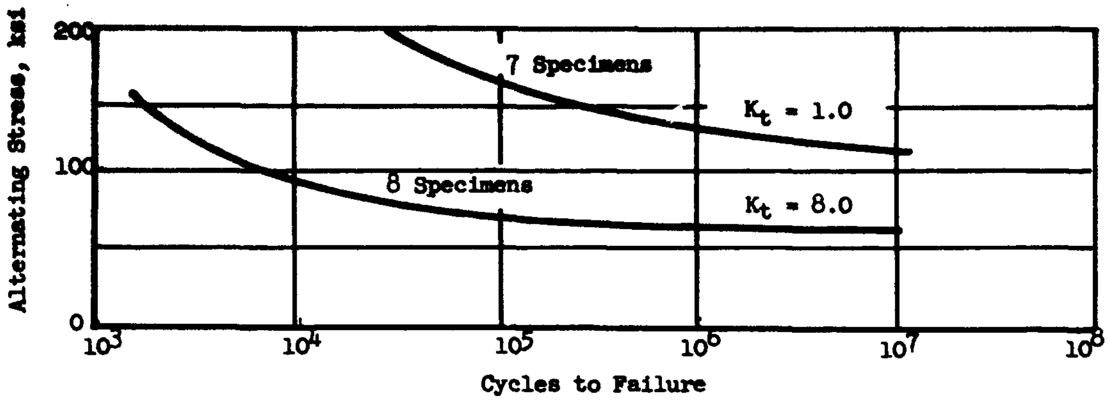

Fig. 56

S-N Curves for 98B40 Steel, 302.6 ksi UTS

(From Ref. 13)

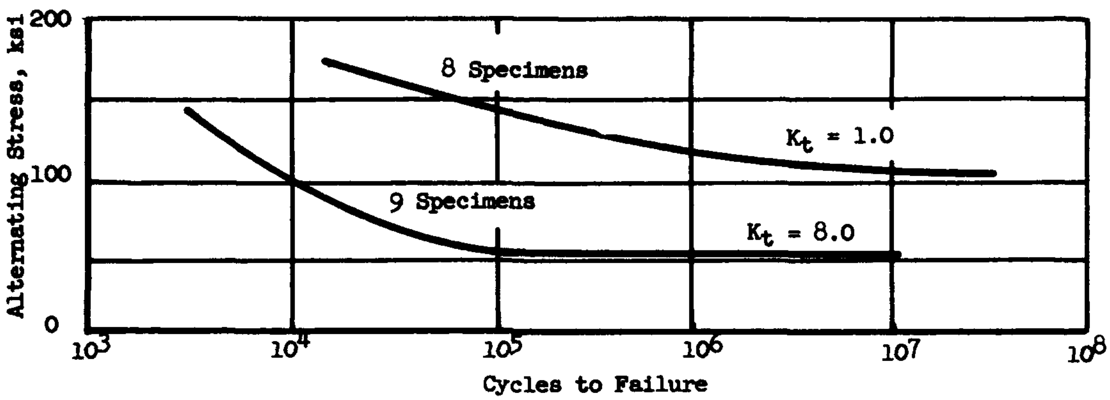

Fig. 57

S-N Curves for 98B40 Steel, 284 ksi UTS

(From Ref. 13)

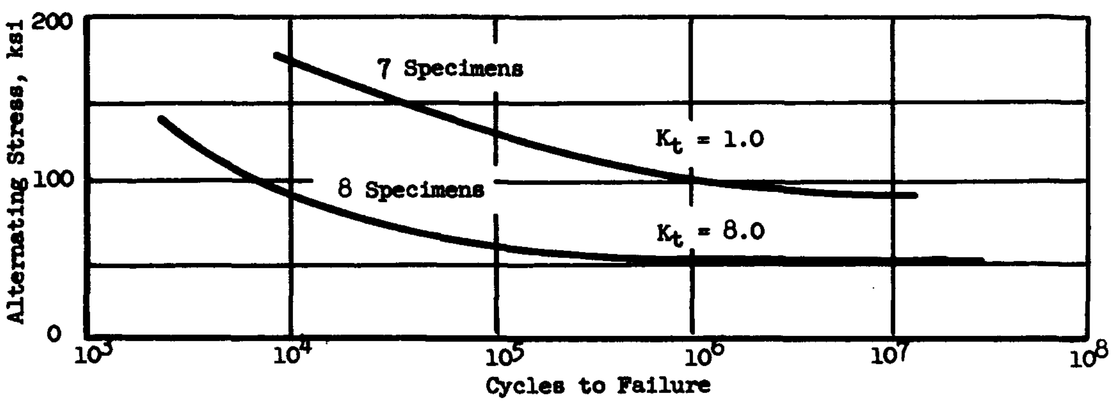

Fig. 58

S-N Curves for 98B40 Steel, 270 ksi UTS

(From Ref. 13)

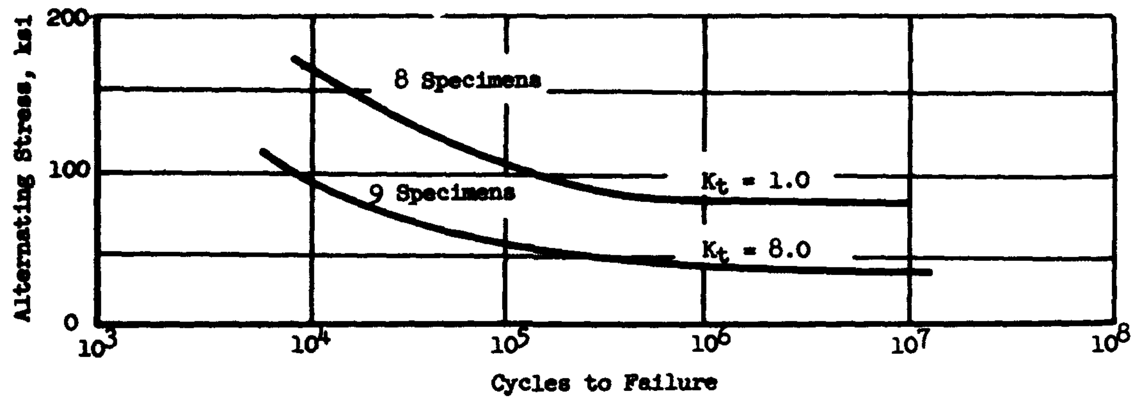

Fig. 59

S-N Curves for 98B40 Steel, 245 ksi UTS

(From Ref. 13)

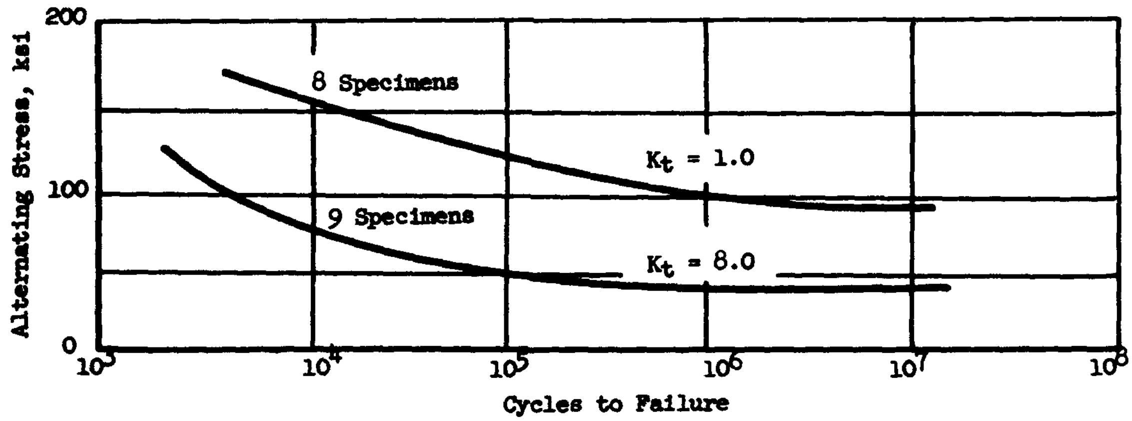

Fig. 60

S-N Curves for 98B40 Steel, 204 ksi UTS

(From Ref. 13)

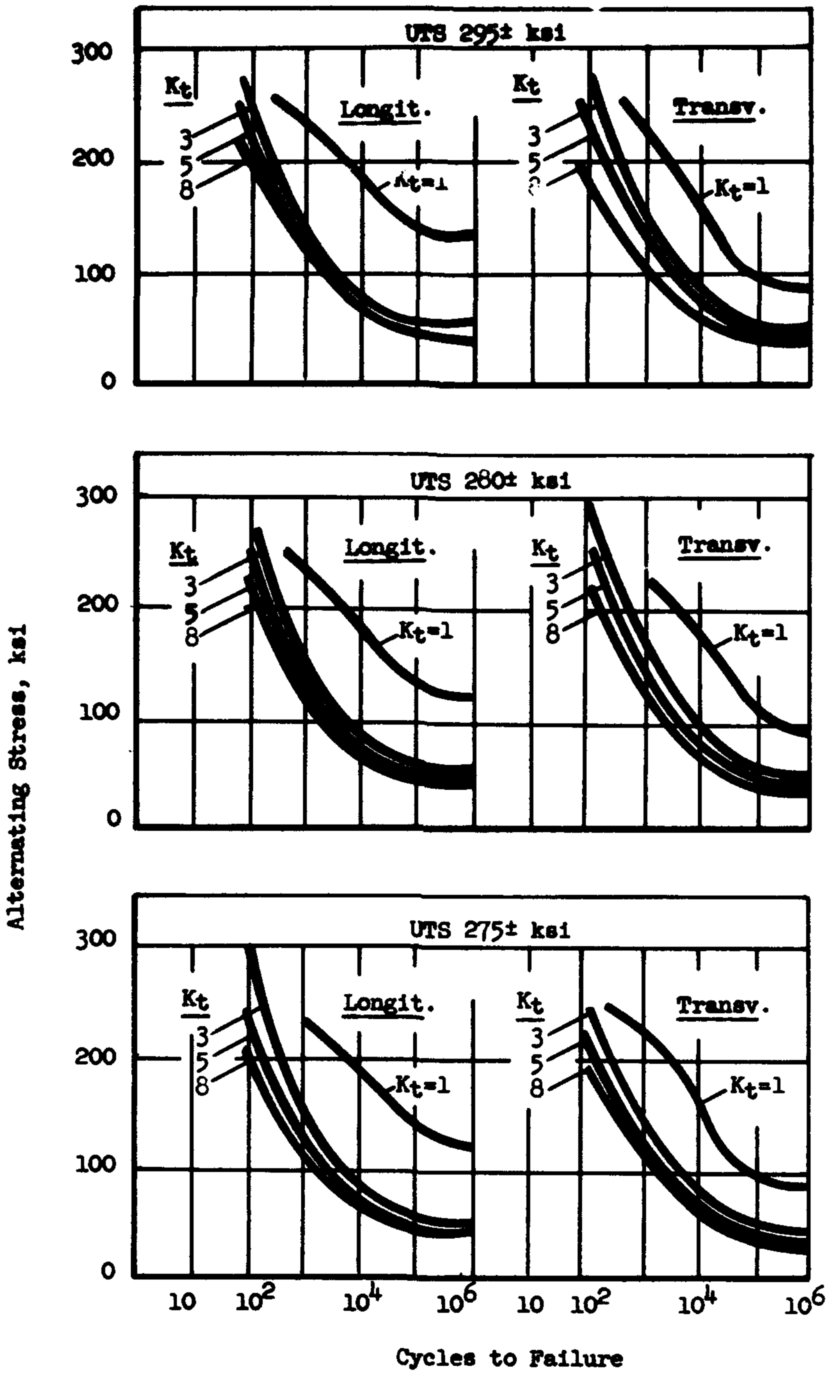

Fig. 61

S-N Curves for Tricent Steel, Smooth and Notched

(From Ref. 34)

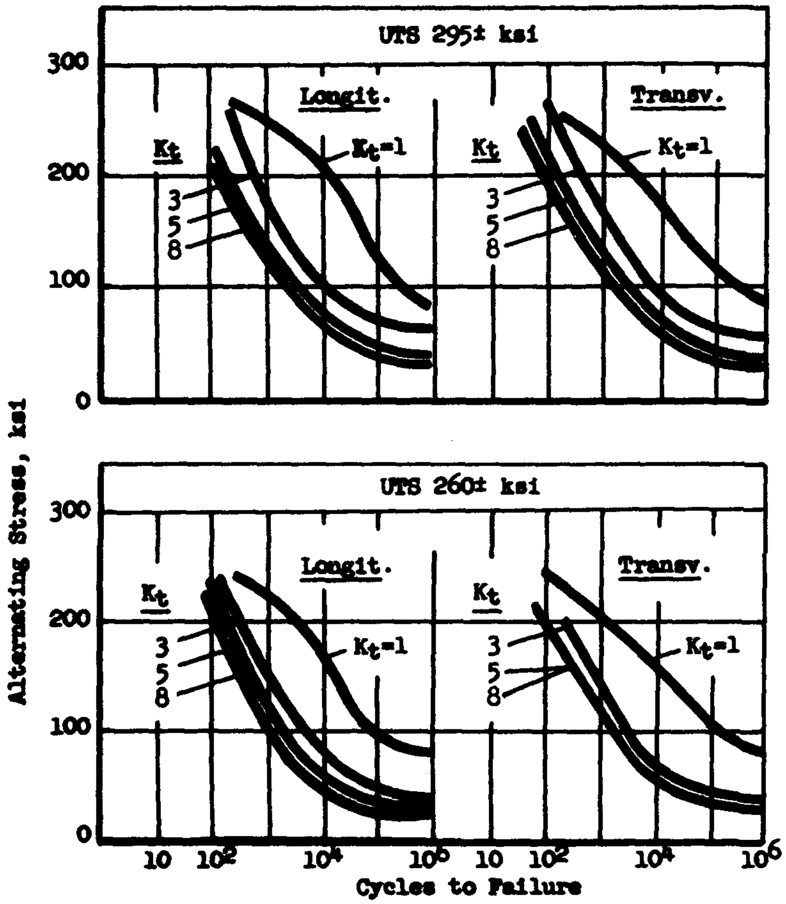

Fig. 62

S-N Curves for Crucible UHS-260 Steel, Smooth and Notched

(From Ref. 34)

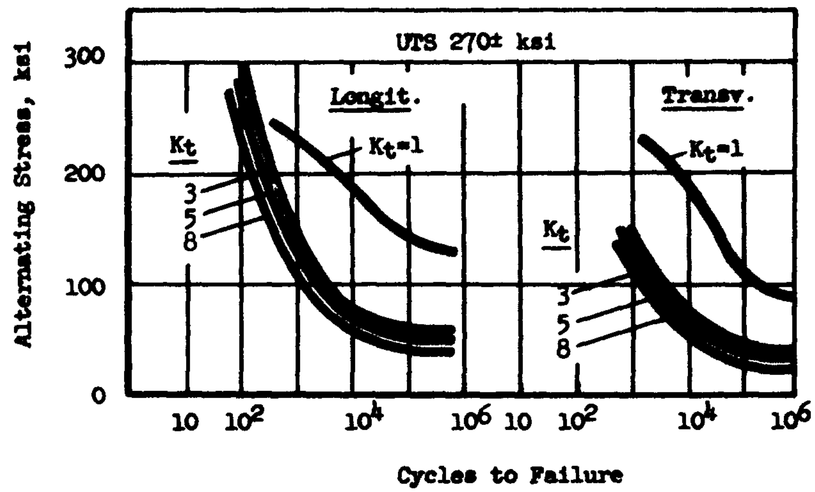

Fig. 63

S-N Curves for Super TM-2 Steel, Smooth and Notched

(From Ref. 34)

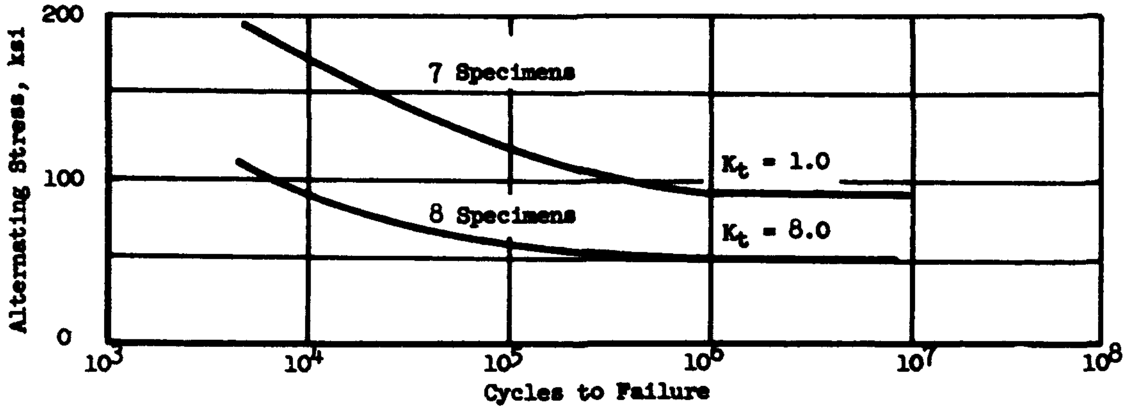

Fig. 64

S-N Curves for Hy-Tuf Steel, 243 ksi UTS

(From Ref. 13)

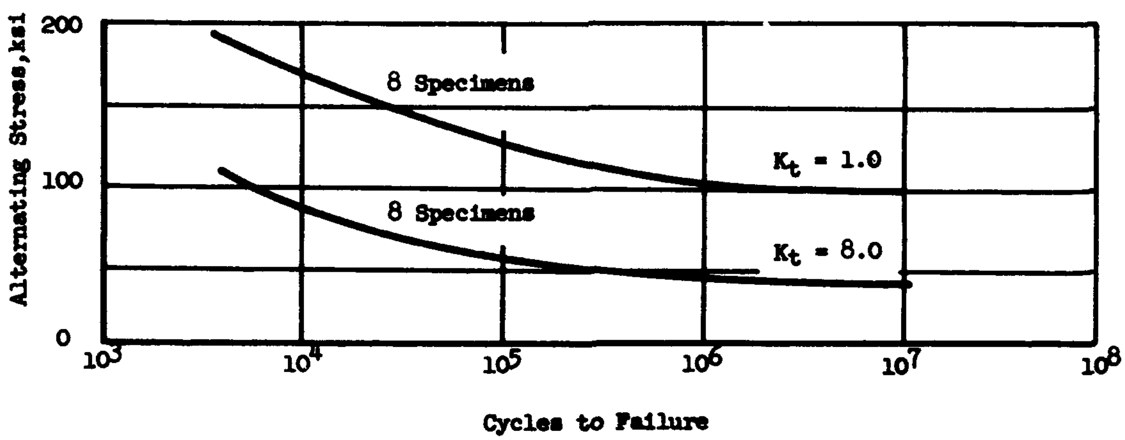

Fig. 65

S-N Curves for Super Hy-Tuf Steel, 260 ksi UTS

(From Ref. 13)

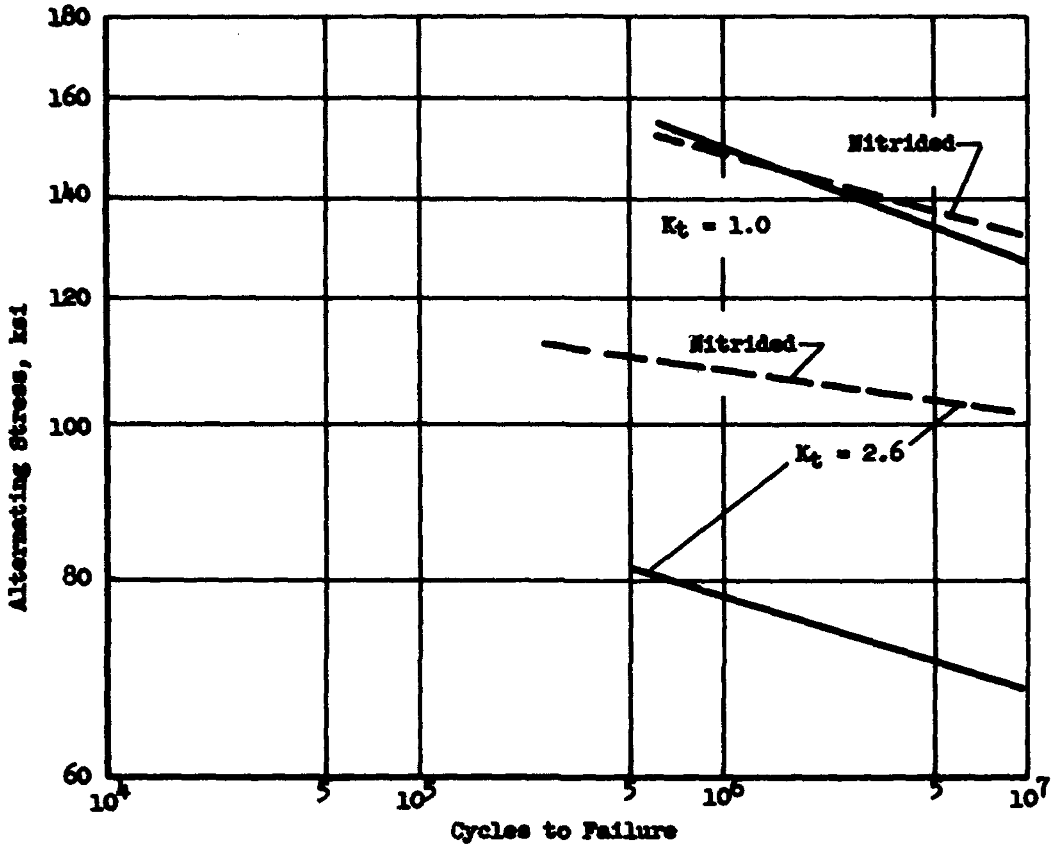

Fig. 66

Approximate S-N Curves for Ferrovac WB-49 Steel, Not Nitrided, and Nitrided

(From ref. 35)

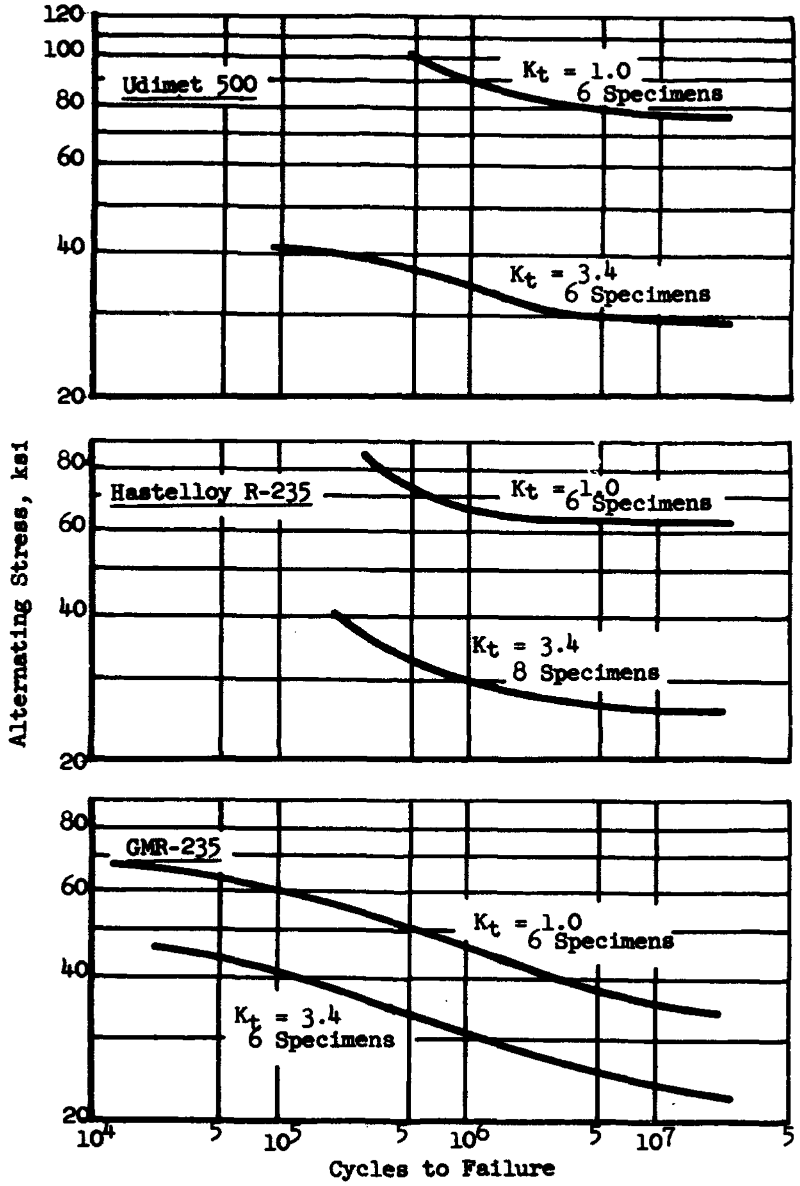

Fig. 67

S-N Curves for Udimet 500, Hastelloy R-235, and GMR-235 Heat Resistant Alloys

(From Ref. 36)

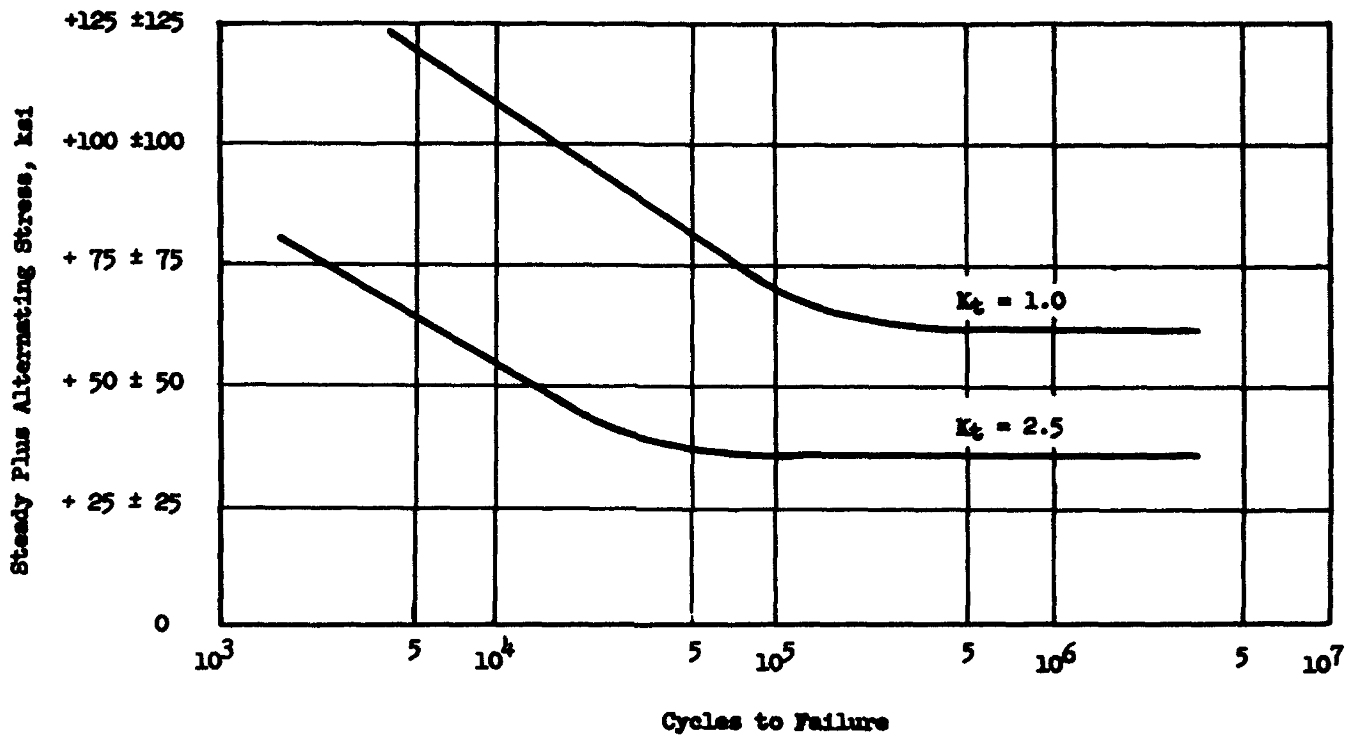

Fig. 68

S-N Curves for SAE H-11 Alloy Steel Bar Heat Treated to 280-300 ksi UTS

(From Ref. 38)

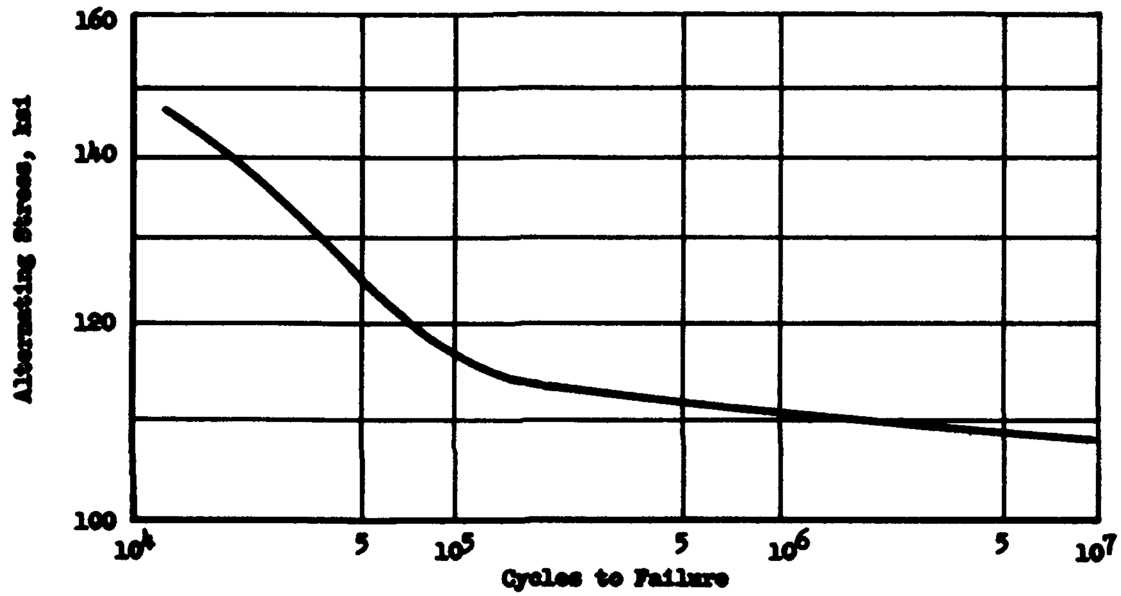

Fig. 69

S-N Curve for H-23 Hot Work Tool Steel

(From ref. 35)

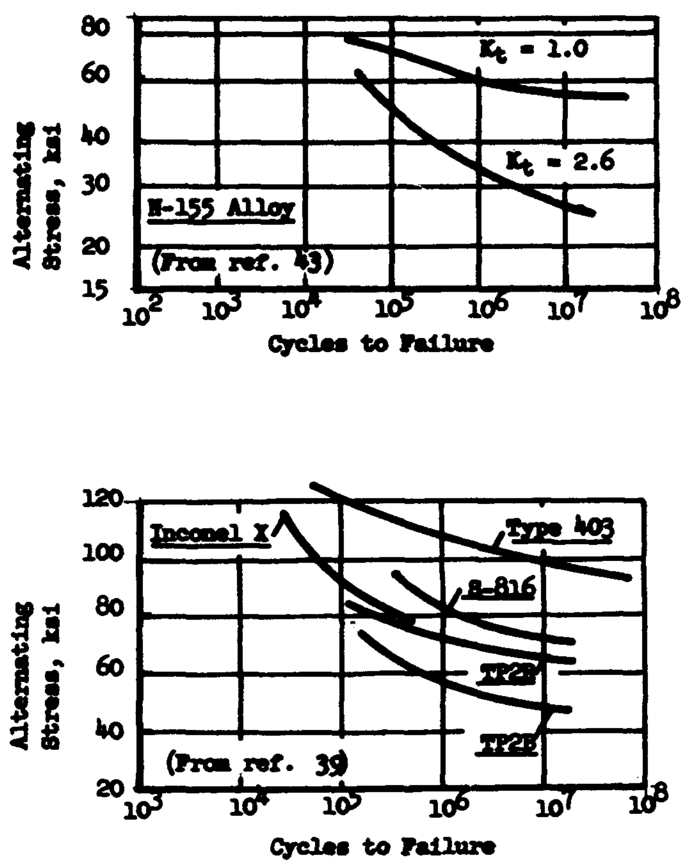

Fig. 70

S-N Curves for Heat Resistant Alloys Tested at Room Temperature

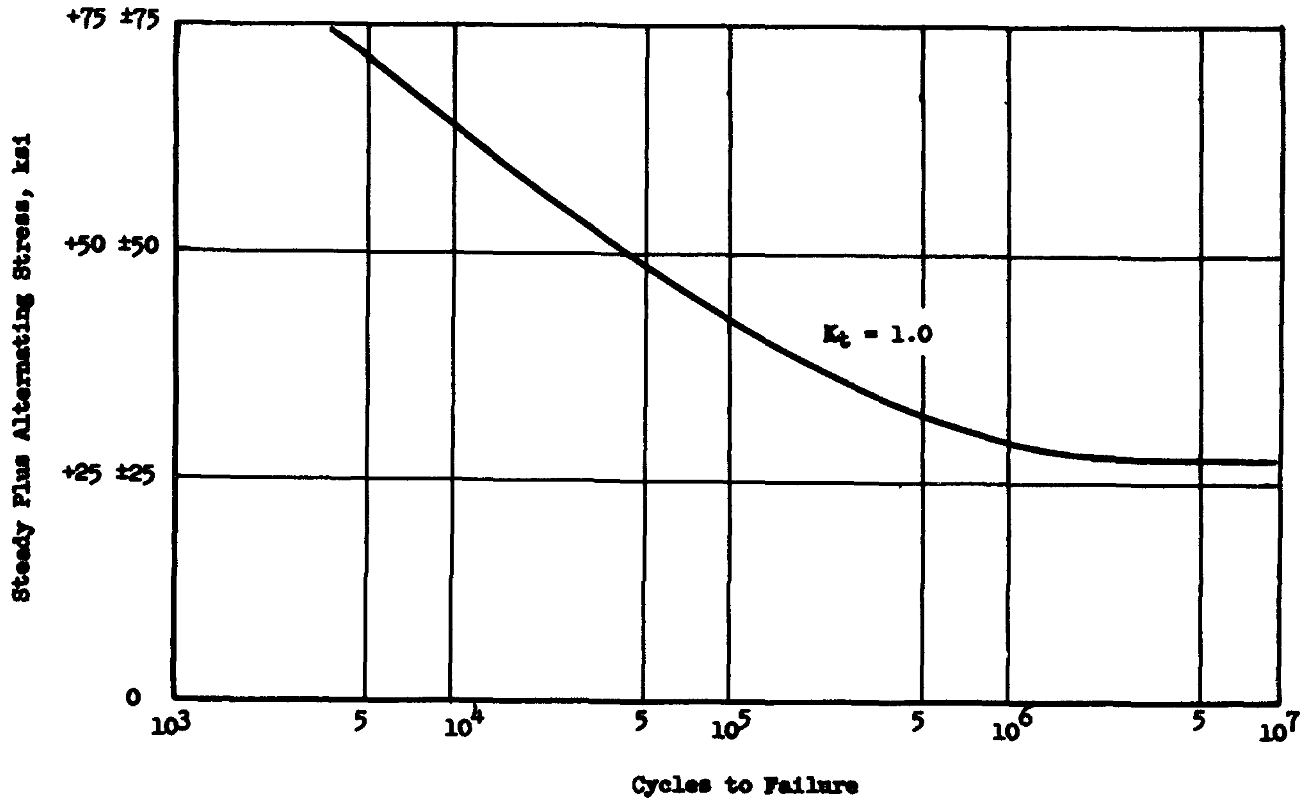

Fig. 71

S-N Curve for Inconel X Sheet, Heat Treated to 155 ksi Minumum UTS.

(From Ref. 38)

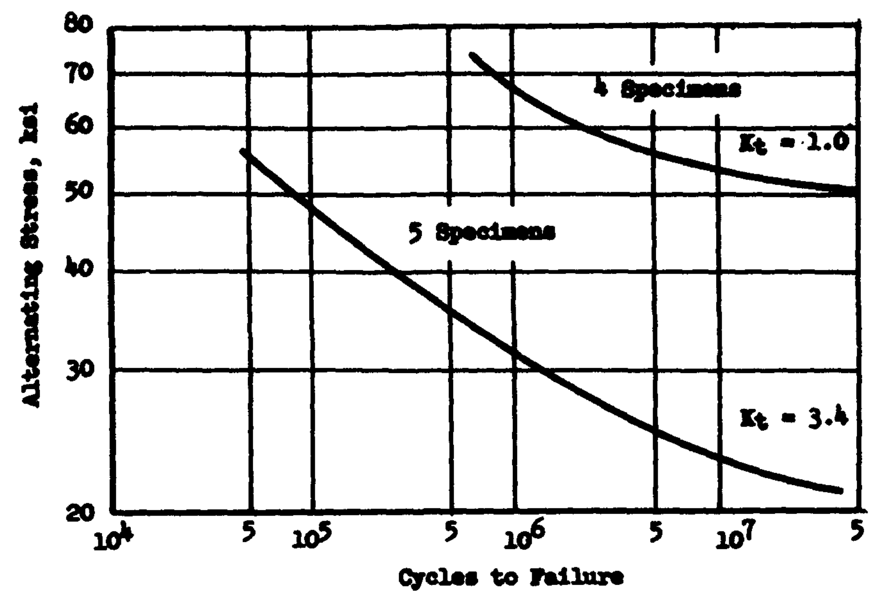

Fig. 72

S-N Curves for Inconel X-550 Alloy

(From Ref. 40)

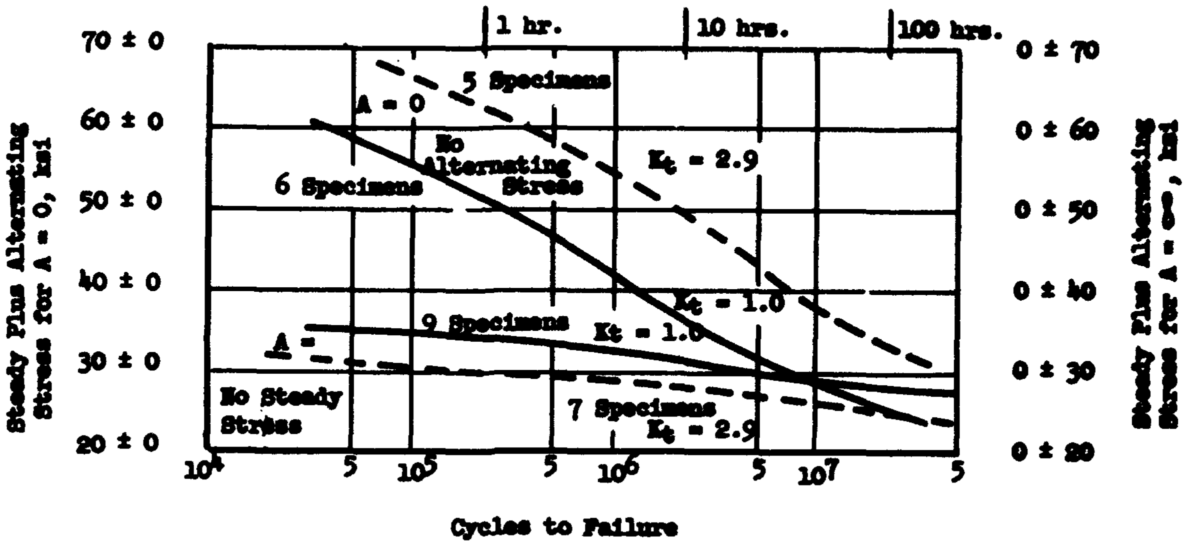

Fig. 73

1700°F S-N Curves for Inconel 713C at Zero Steady Stress and at Zero Alternating Stress

(From Ref. 41)

Note: A = ratio of alternating to steady stress

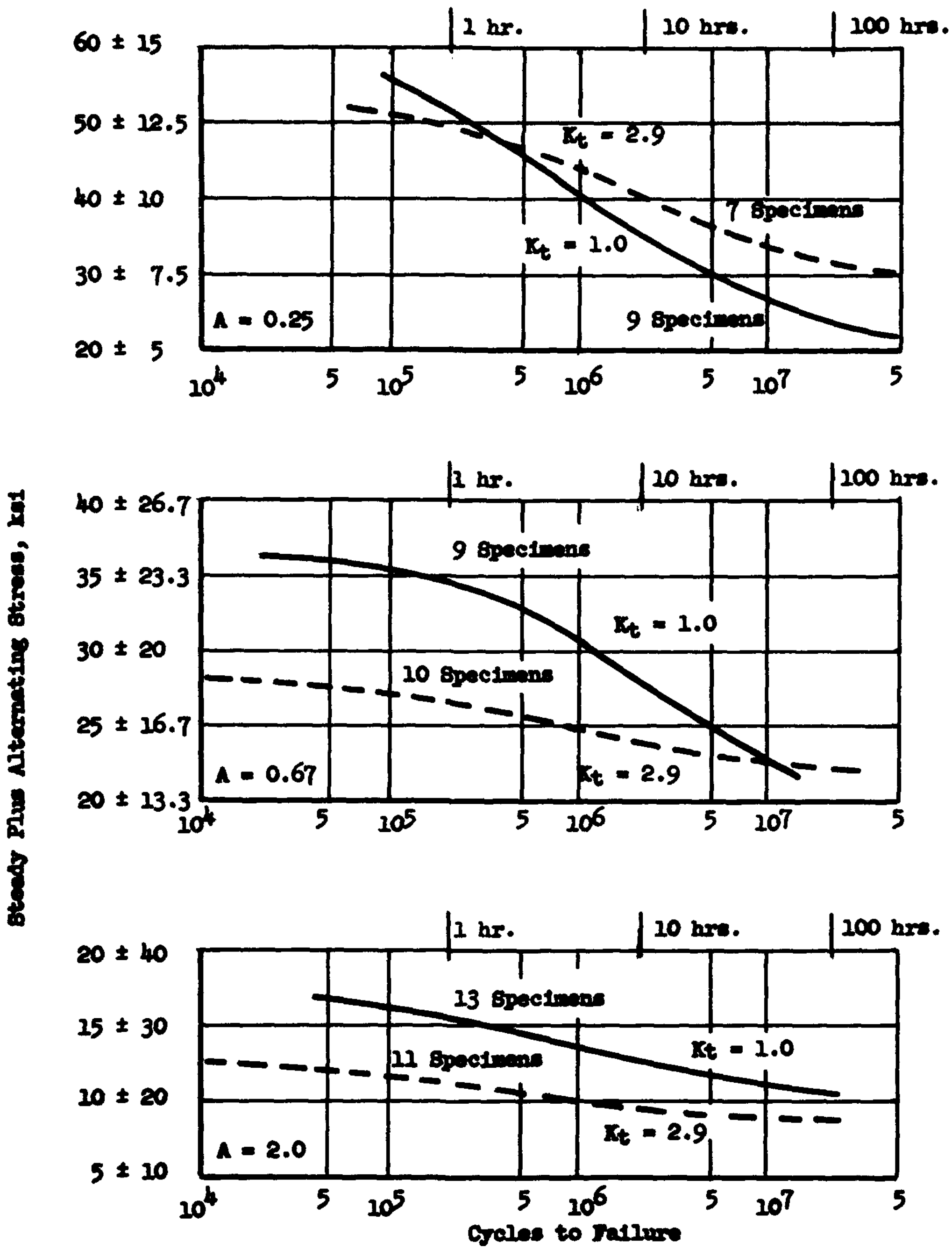

Fig. 74

1700°F S-N Curves for Inconel 713C at Several Combinations of Steady and Alternating Stress

(From Ref. 41)

Note: A = ratio of alternating to steady stress.

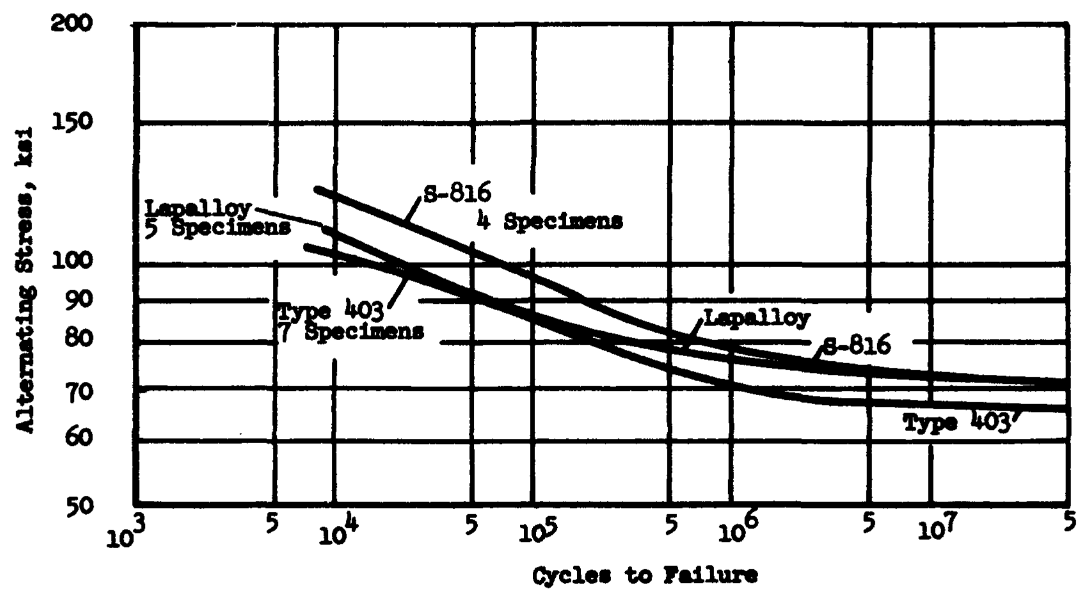

Fig. 75

S-N Curves for S-816, Lapalloy, and Type 403 Alloys

(From Ref. 42)

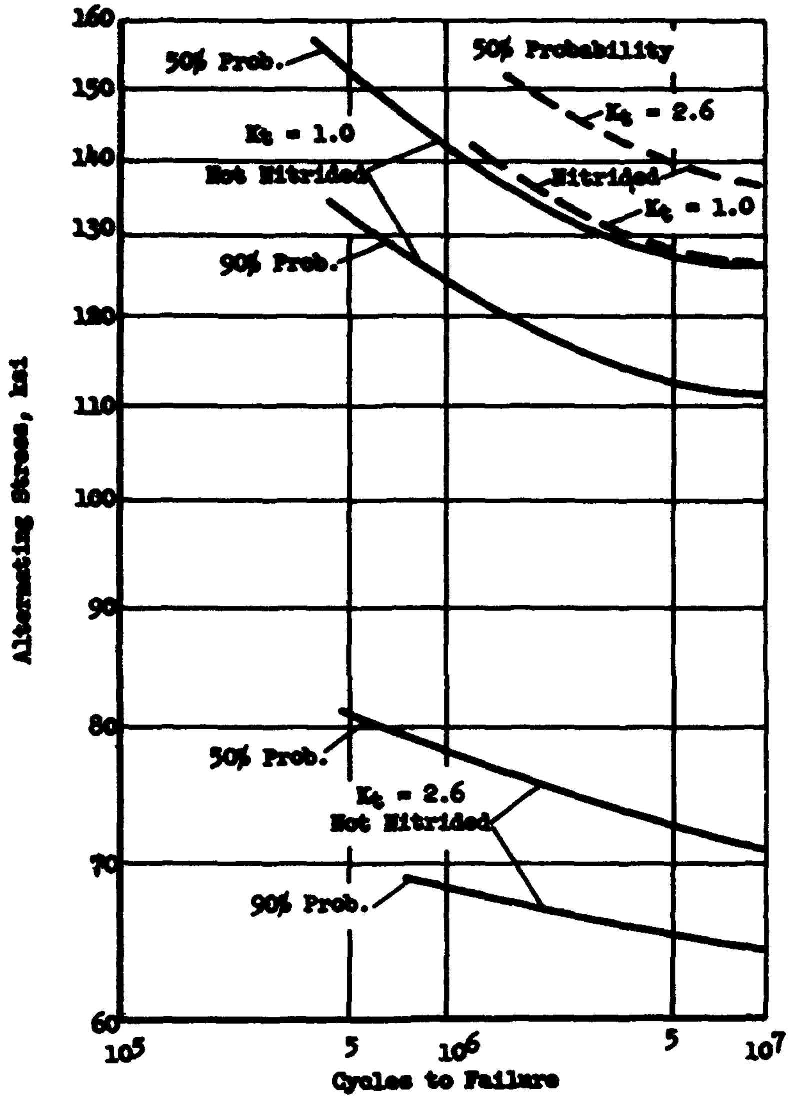

Fig. 76

S-N Curves for M-10 Steel, Rc 61-62, Not Nitrided and Nitrided. Constant Probability of Survival of Stress at Constant Life.

(From ref. 35)

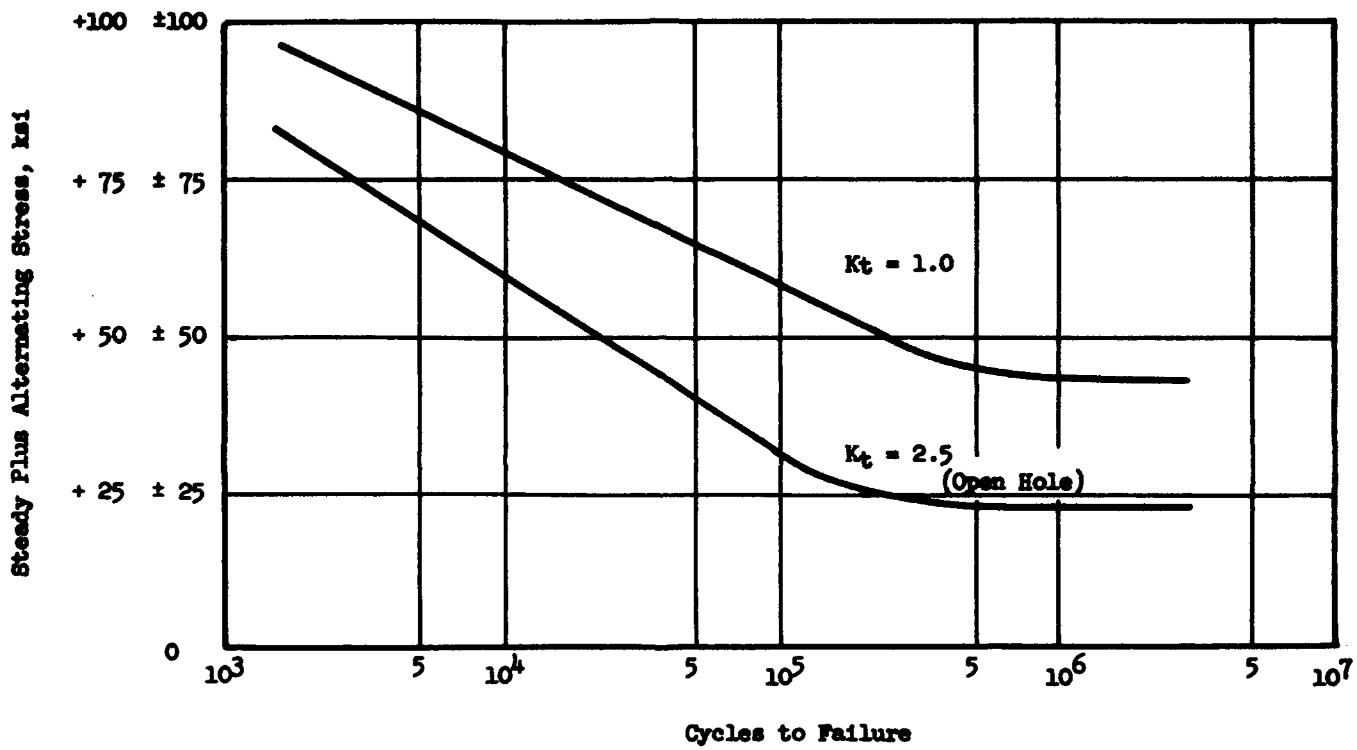

Fig. 77

S-N Curves for PH 15-7 Mo Stainless Steel, Condition RH950, Heat Treated to 225 ksi Minimum UTS

(From Ref. 38)

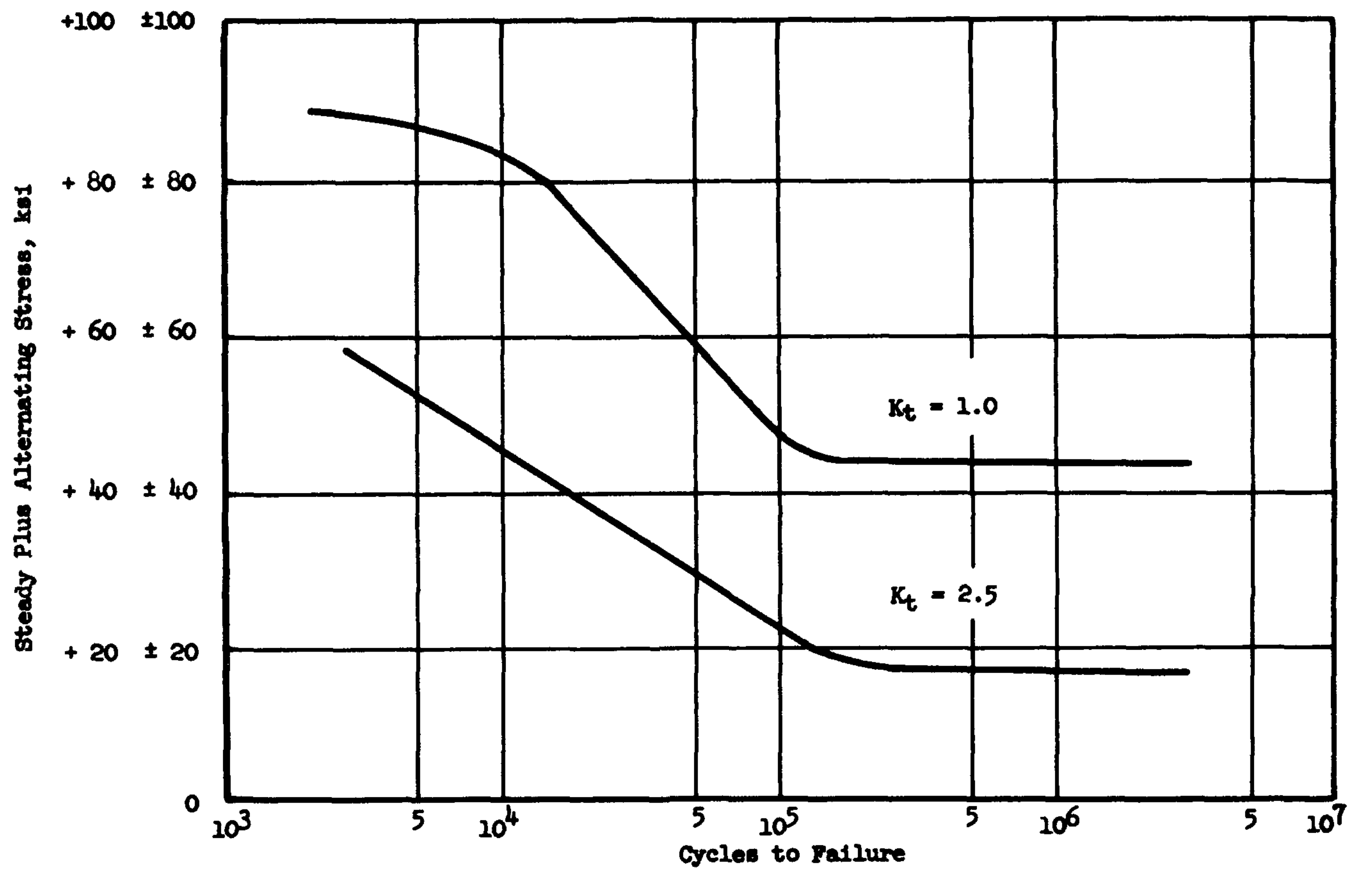

Fig. 78

S-N Curves for 17-7 PH Stainless Steel, Condition TH 1050, Heat Treated to 180 ksi Minimum UTS

(From Ref. 38)

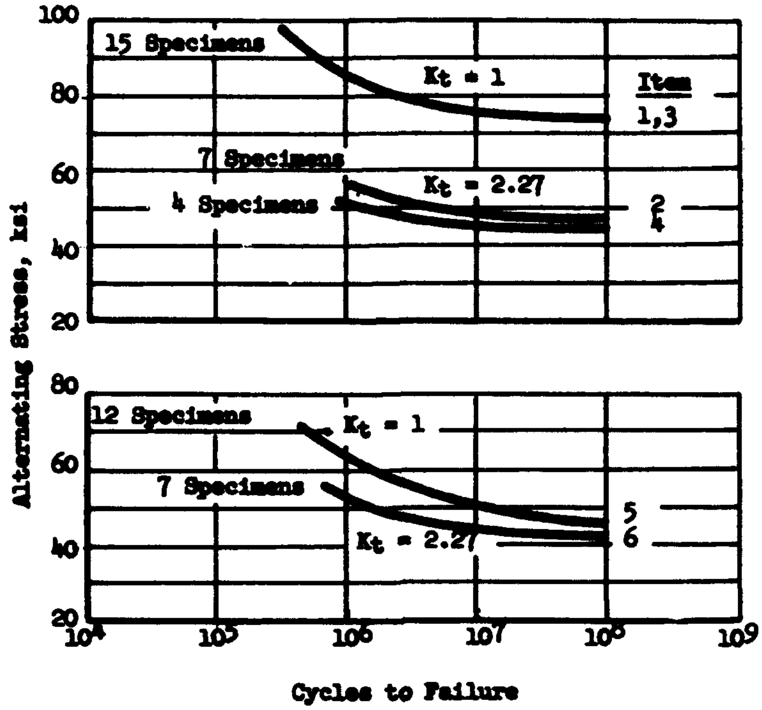

Fig. 79

S-N Curves for Refractaloy 26

At Room Temperature

(From ref. 44)

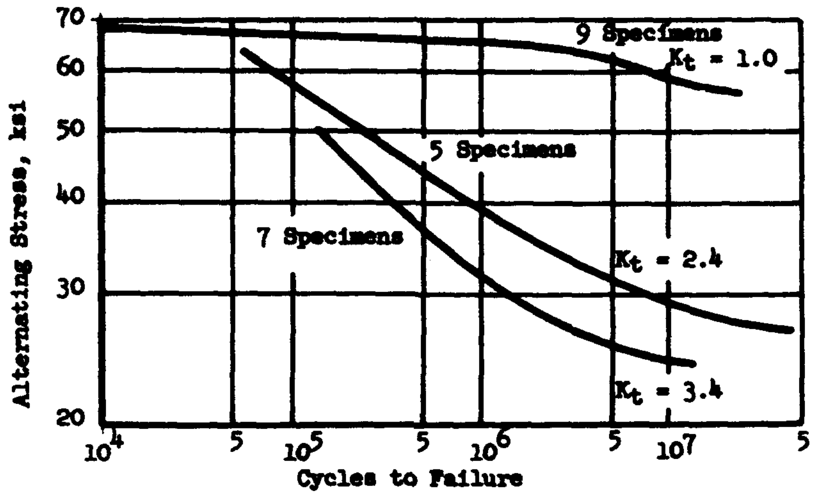

Fig. 80

S-N Curves for S-816 Alloy

(From Ref. 40)

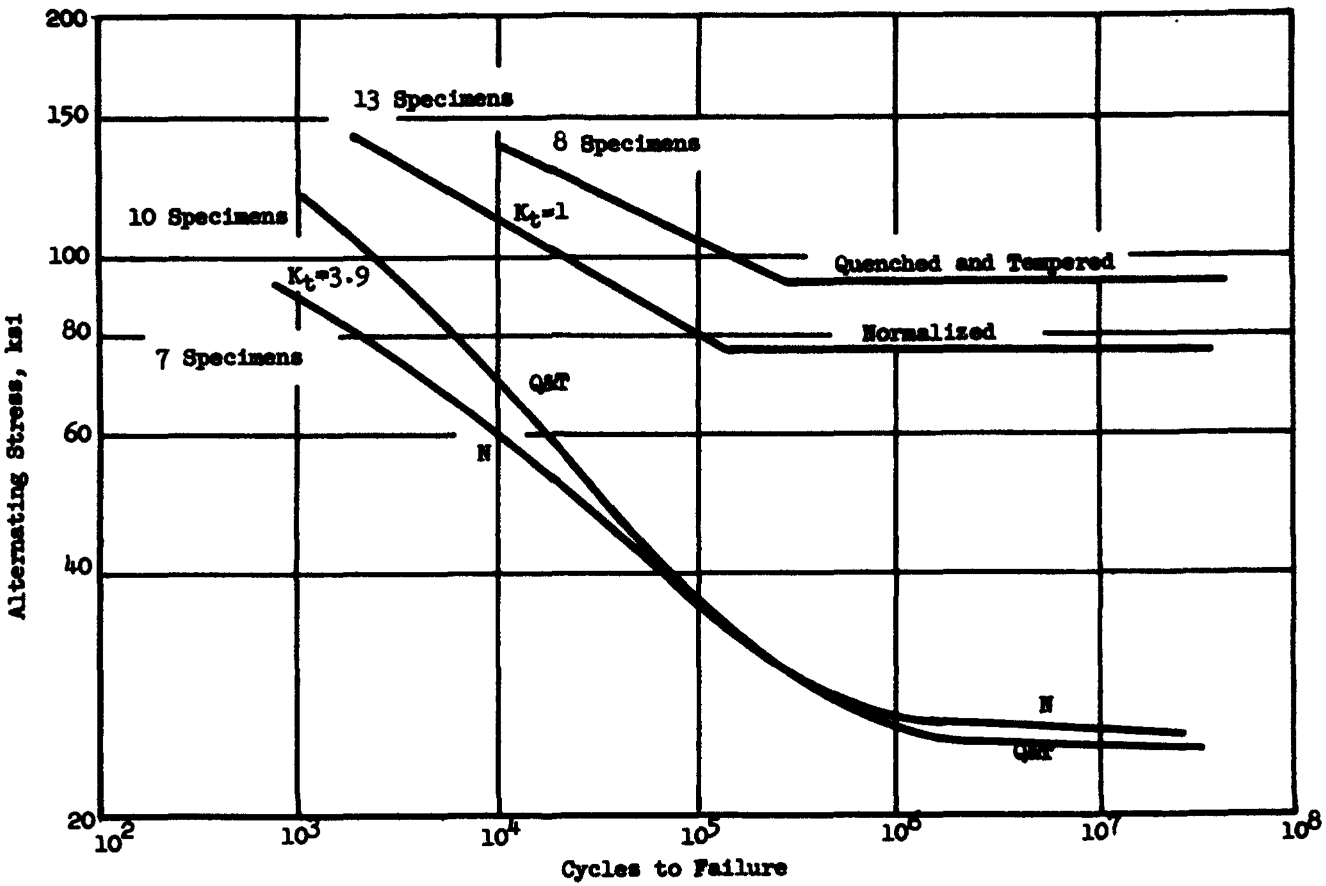

Fig. 81

S-N Curves for Sandvik Steel, for Two Heat Treatments

(From Ref. 4)

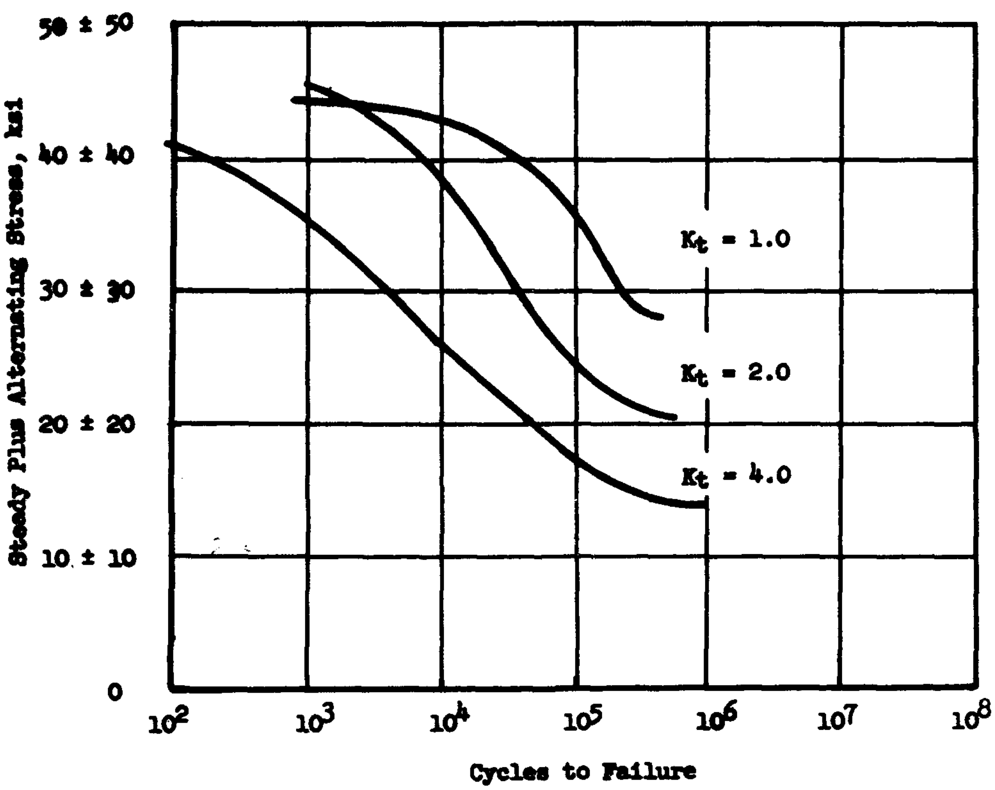

Fig. 82

S-N Curves for 347 Stainless Steel, Showing Steady Plus Alternating Stress

(From Ref. 45)

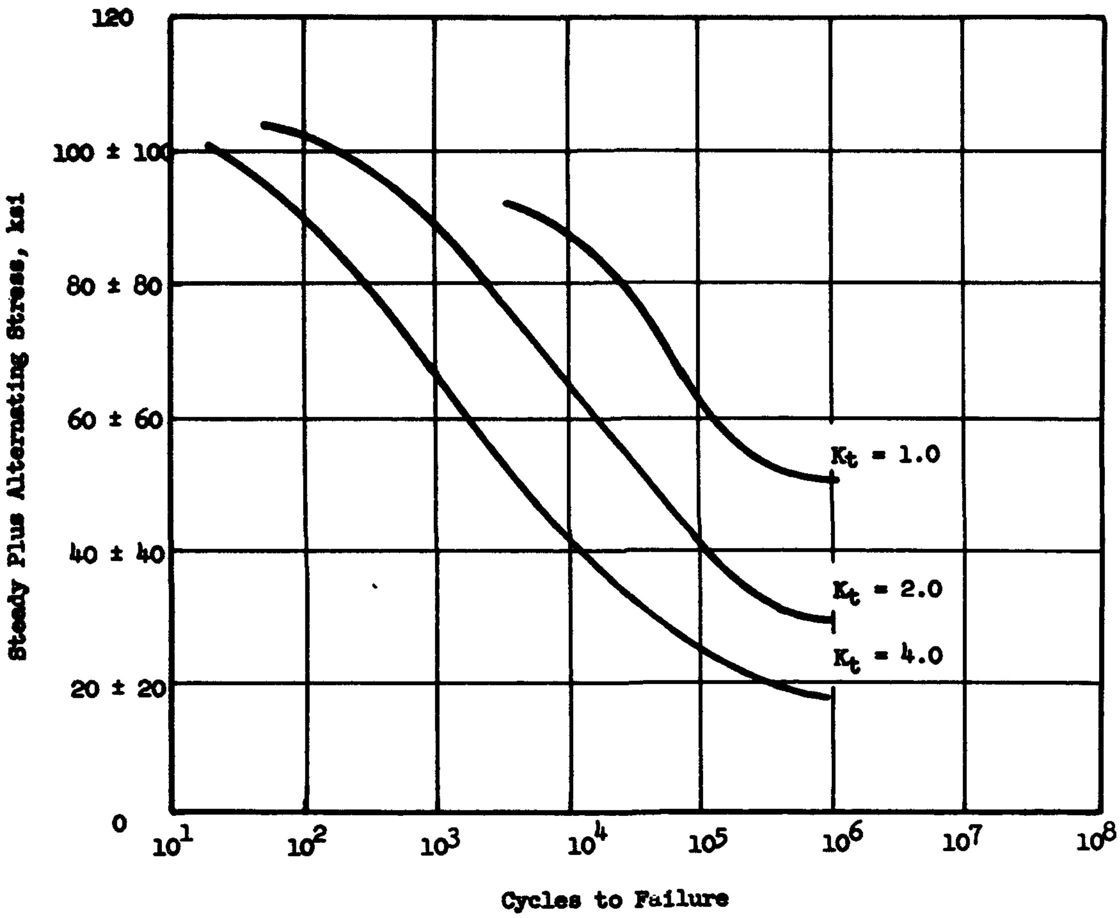

Fig. 83

S-N Curves for 403 Stainless Steel, Showing Steady Plus Alternating Stress

(From Ref. 45)

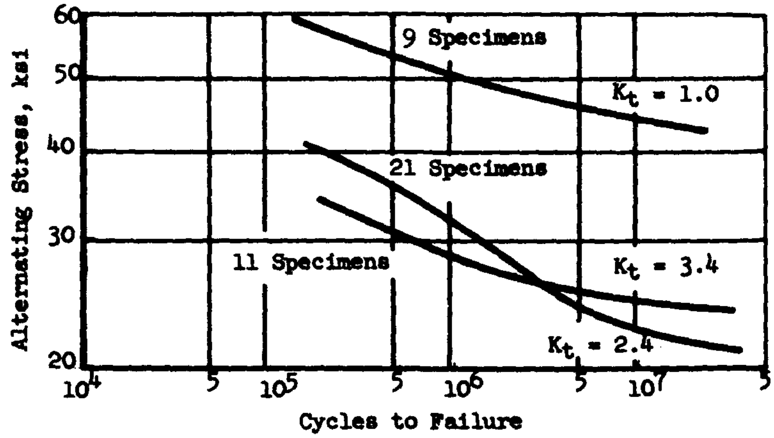

Fig. 84

S-N Curves for Stellite 31 (X-40) Alloy

(From Ref. 40)

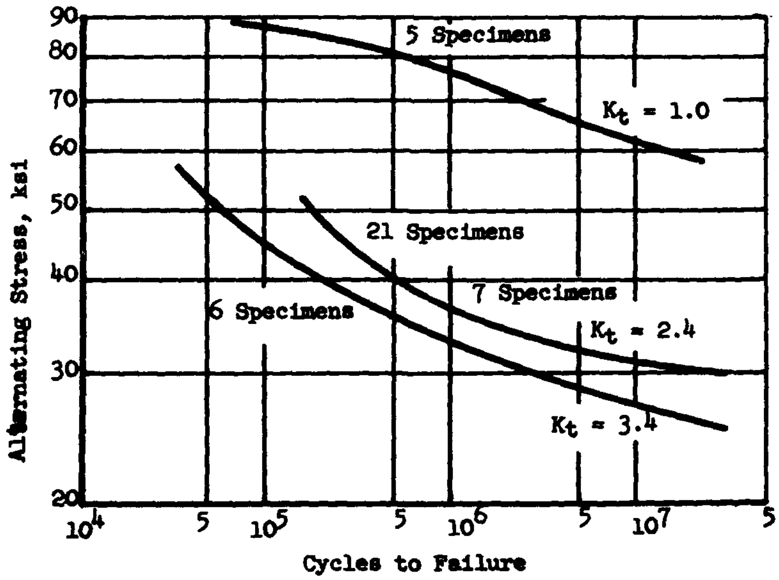

Fig. 85

S-N Curves for 6.3% Mo-Waspalloy

(From Ref. 40)

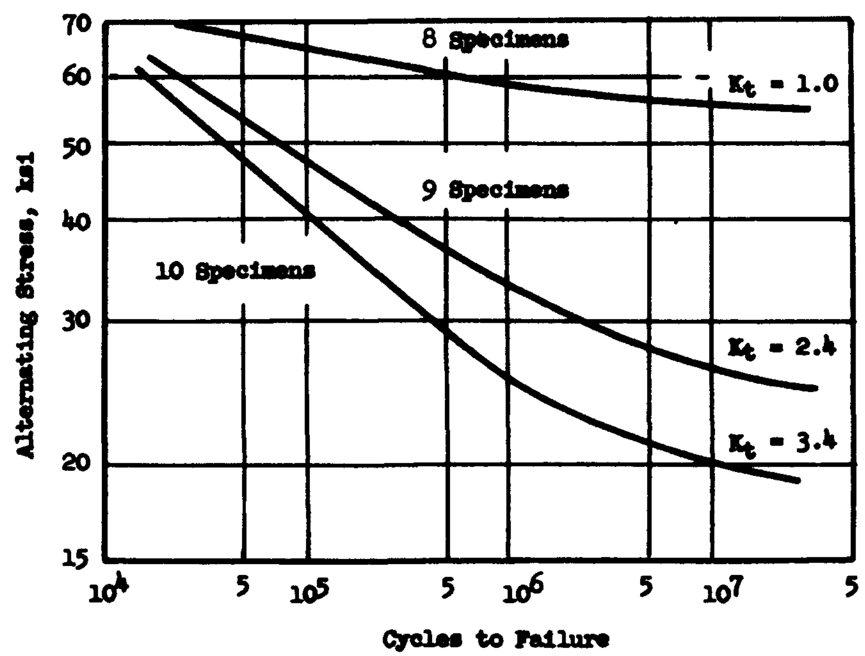

Fig. 86

S-N Curves for 16-25-6 Timken Alloy

(From Ref. 40)

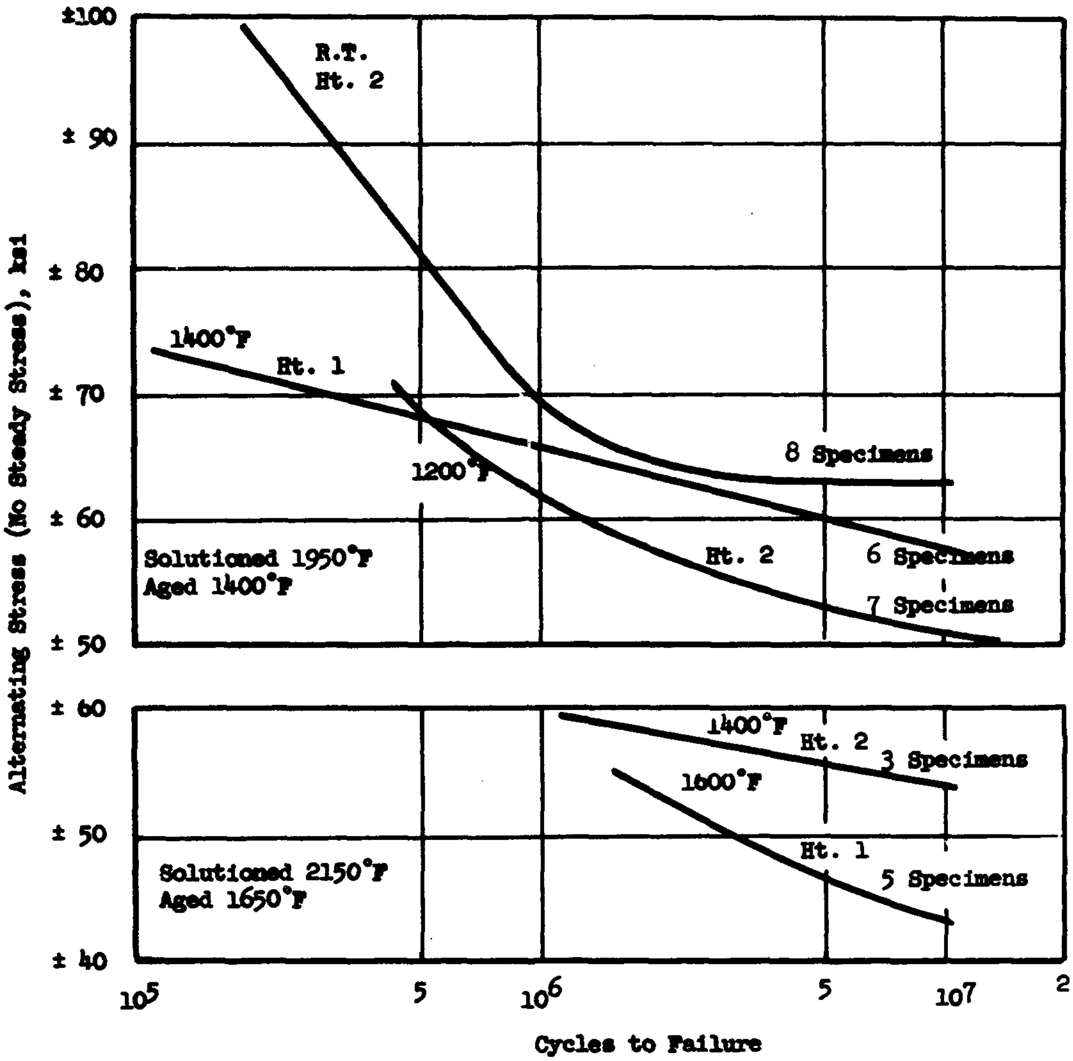

Fig. 87

S-N Curves for Smooth Rene 41 Alloy, for Two Heat Treatments, at Room Temperature, 1200°, 1400°, and 1600°F, With Zero Steady Loads (A = ∞)

(From Ref. 46)

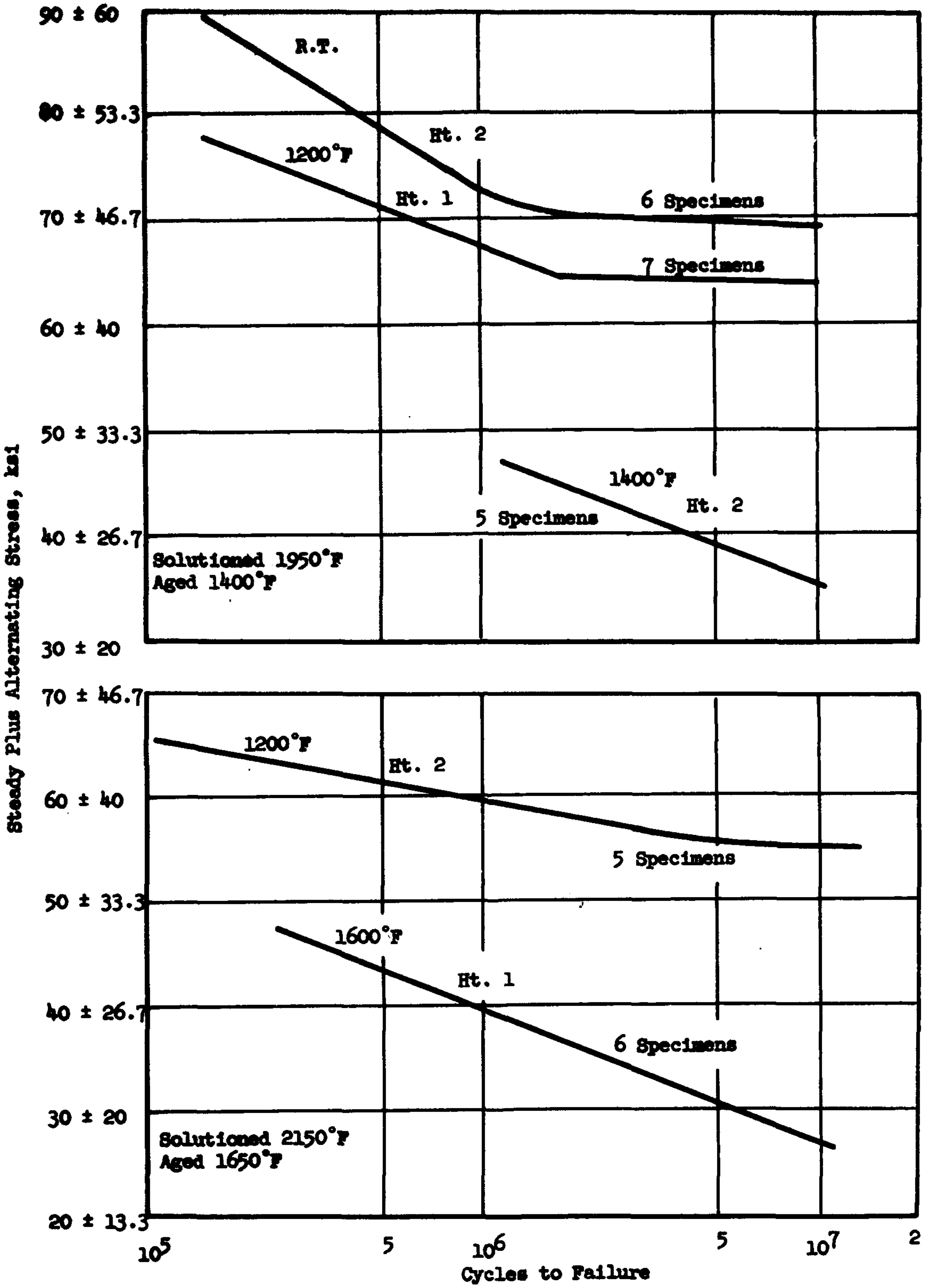

Fig. 88

S-N Curves for Smooth Rene 41 Alloy, for Two Heat Treatments, at Room Temperature, 1200°, 1400°, and 1600°F, With Steady Loads (A = 0.67) (From Ref. 46)

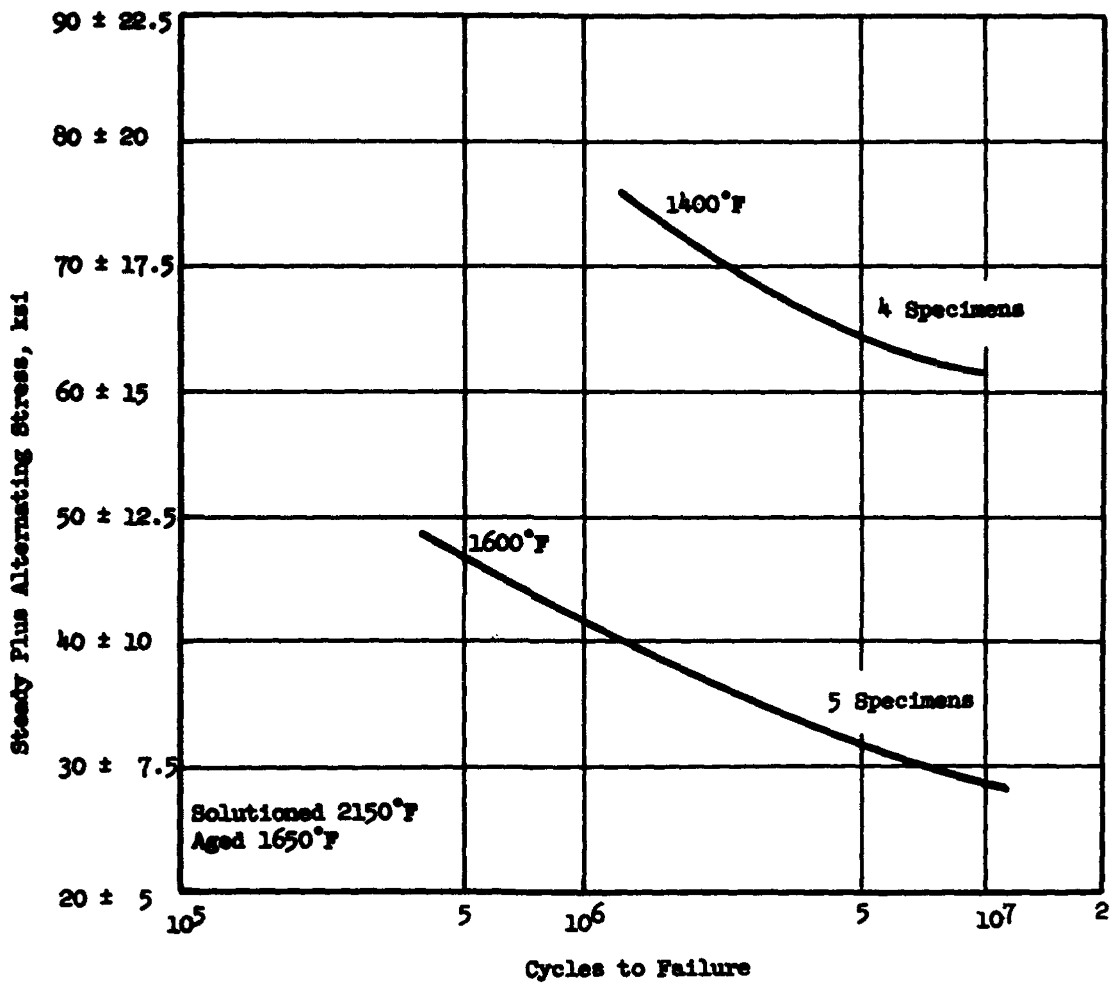

Fig. 89

S-N Curves for Smooth Rene 41 Alloy, for One Heat Treatment, at 1400° and 1600°F, With Steady Loads (A = 0.25)

(From Ref. 46)

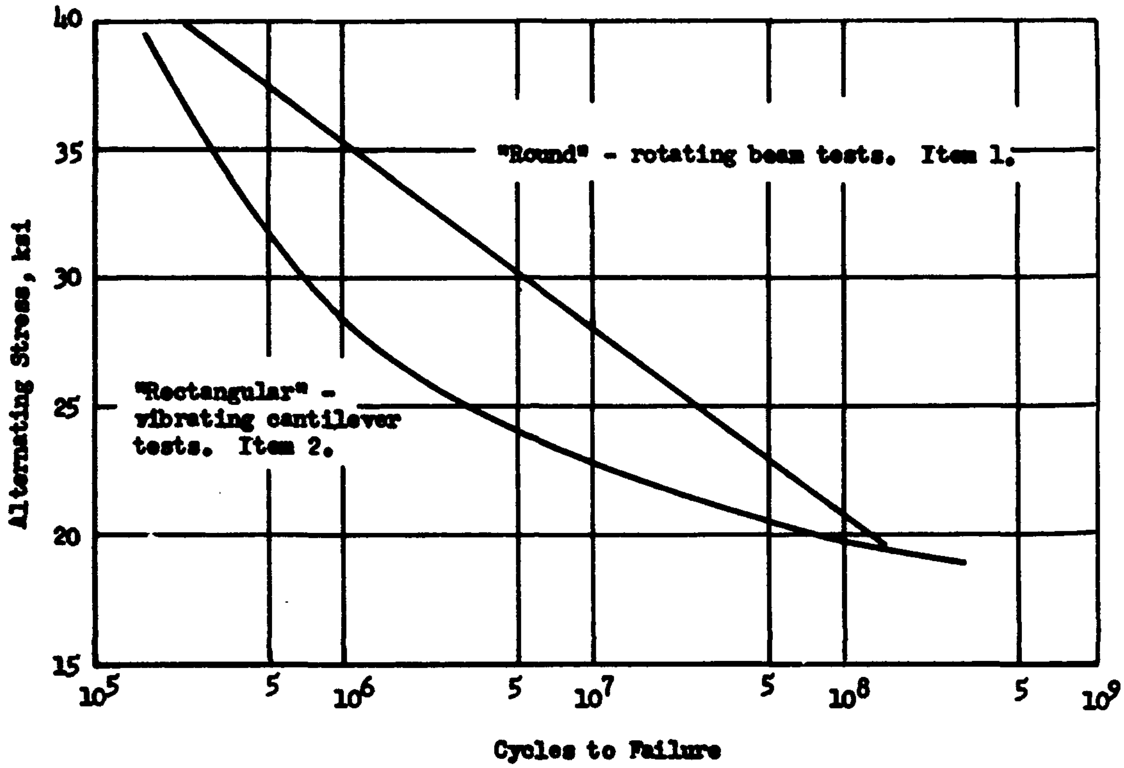

Fig. 90

S-N Curves for Aluminum Alloy 2014 (14S-T), Extruded

(From ref. 47)

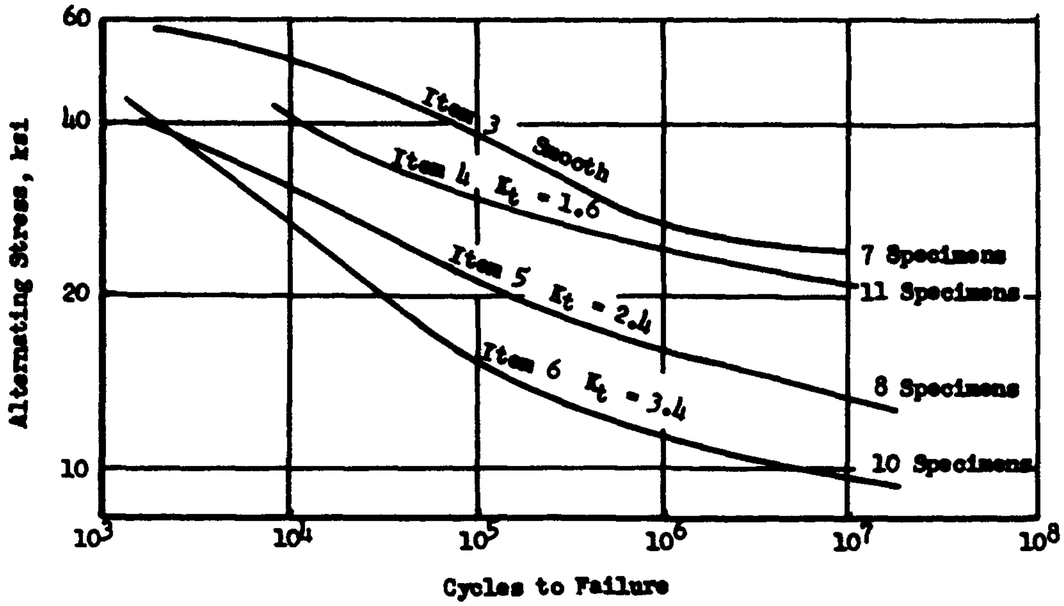

Fig. 91

S-N Curves for Aluminum Alloy 2014-T6 (14S-T6), Rolled.

(From ref. 48)

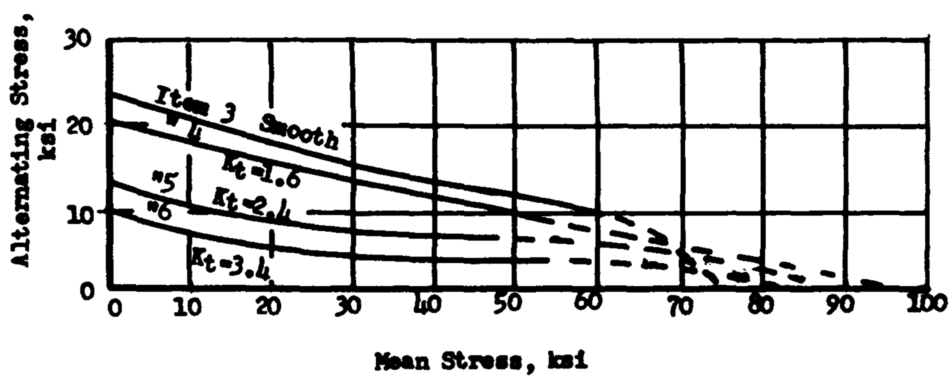

Fig. 92

Alternating vs. Mean Stress, for N = 10^7 Cycles, for 14S-T6 Aluminum Alloy, Rolled.

(From ref. 48)

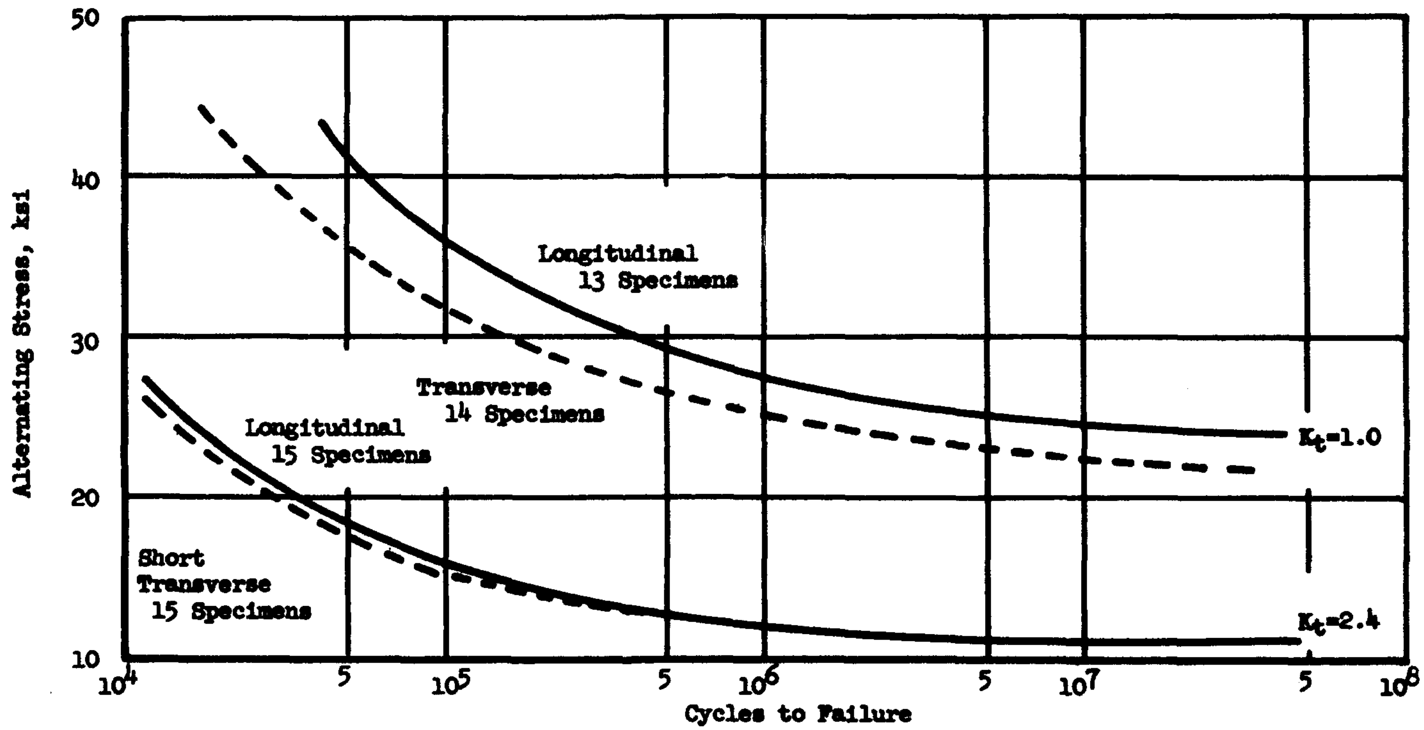

Fig. 93

S-N Curves for 2014-T6 Aluminum Alloy, Hand Forged. Longitudinal, and Short Transverse, Axial Tests.

(From Ref. 49)

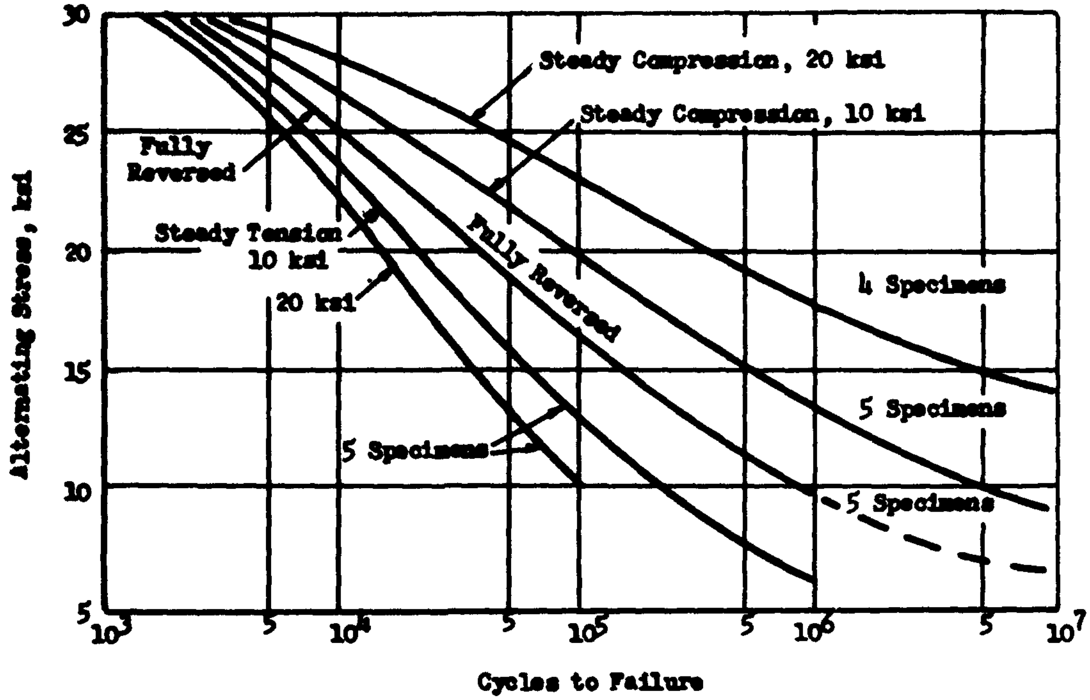

Fig. 94

S-N Curves for Notched Alclad 24S-T3, K_t = 2.5

(From ref. 51)

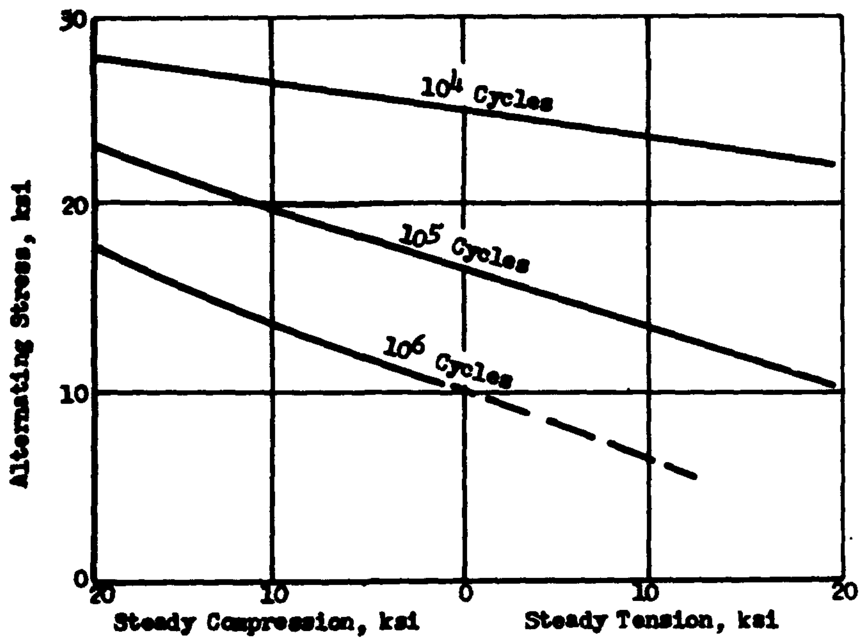

Fig. 95

Alternating vs. Steady Stress for Notched Alclad 24S-T3, K_t = 2.5

(From ref. 51)

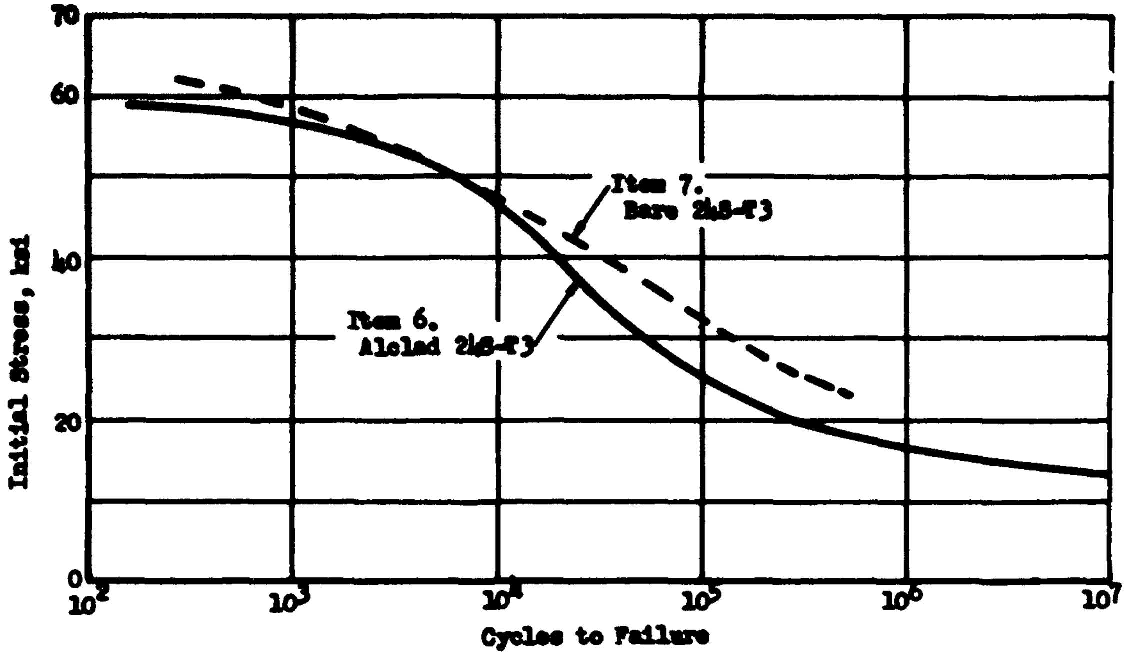

Fig. 96

S-N Curves for Alclad and for Bare 24S-T3, Smooth

(From ref. 52)

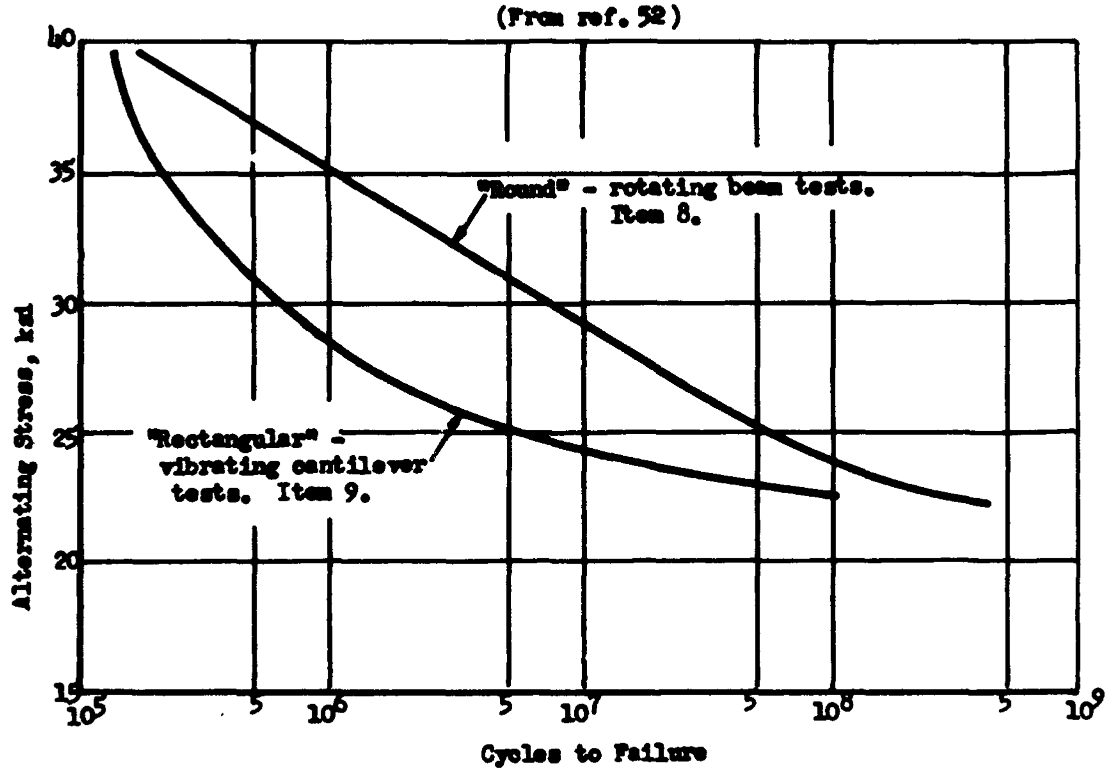

Fig. 97

S-N Curves for Aluminum Alloy 24S-T, Extruded

(From ref. 47)

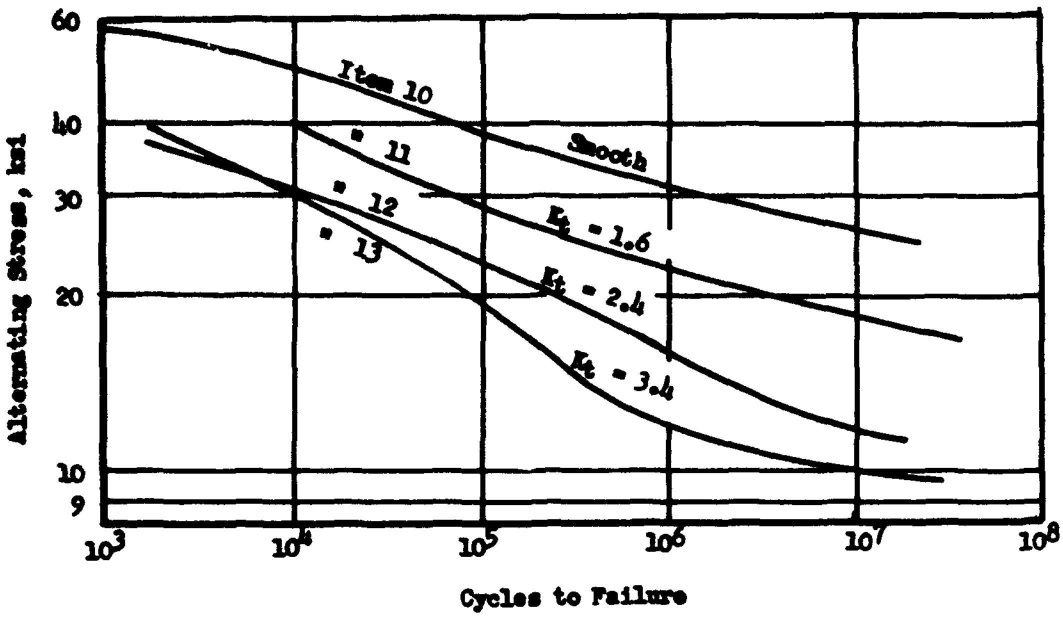

Fig. 98

S-N Curves for 24S-T4 Aluminum Alloy, Rolled.

(From ref. 48)

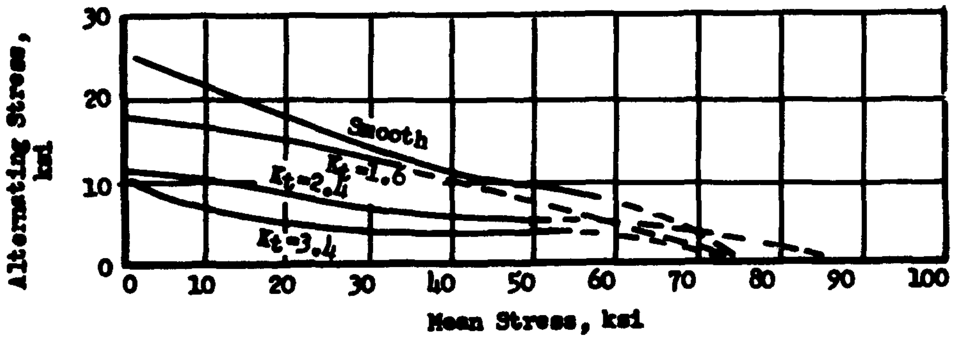

Fig. 99

Alternating vs. Mean Stress, for N = 10^7 Cycles for 24S-T4 Aluminum Alloy, Rolled

(From ref. 48)

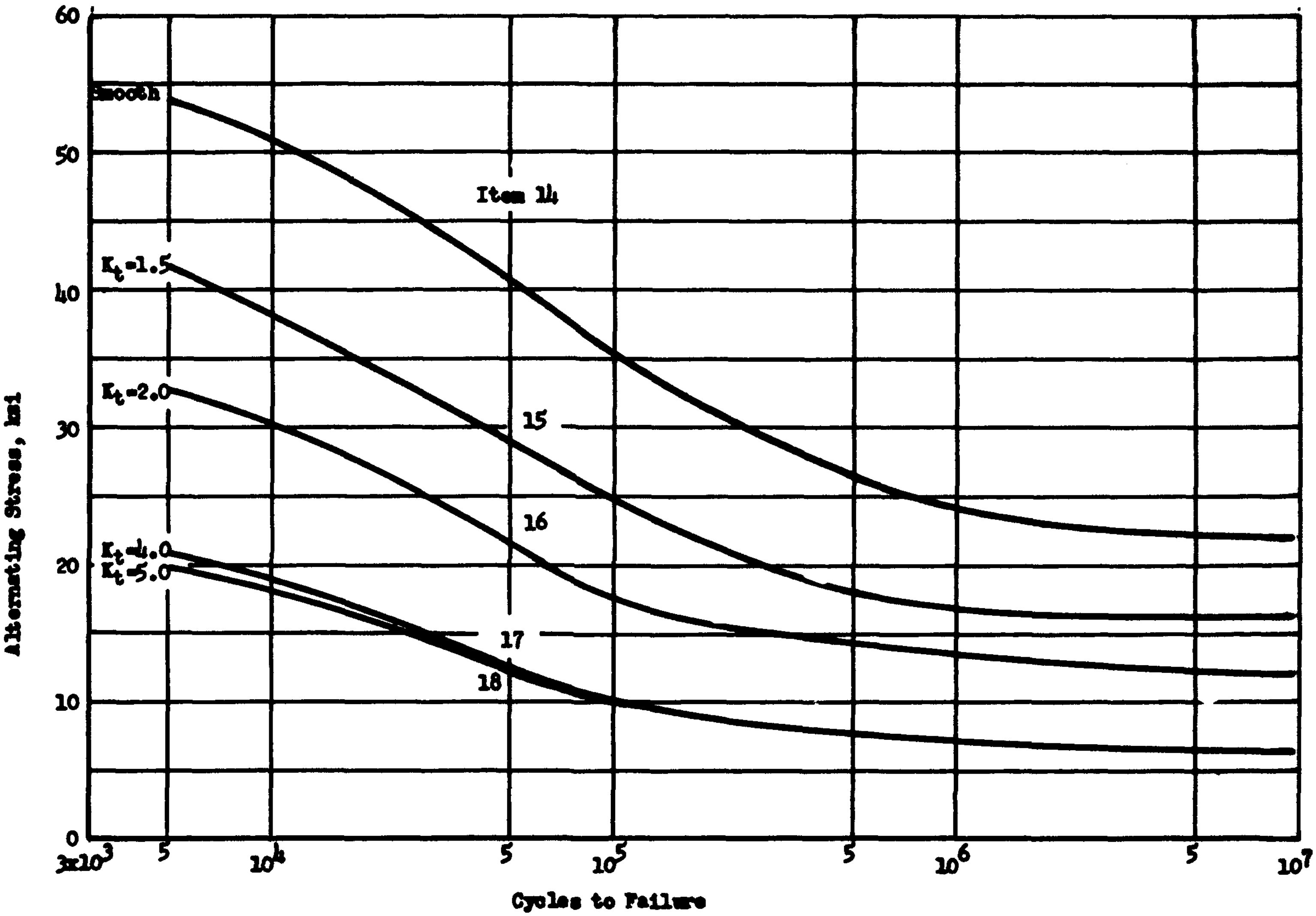

Fig. 100

S-N Curves for 24S-T3 Plate, Fully Reversed

(From ref. 10)

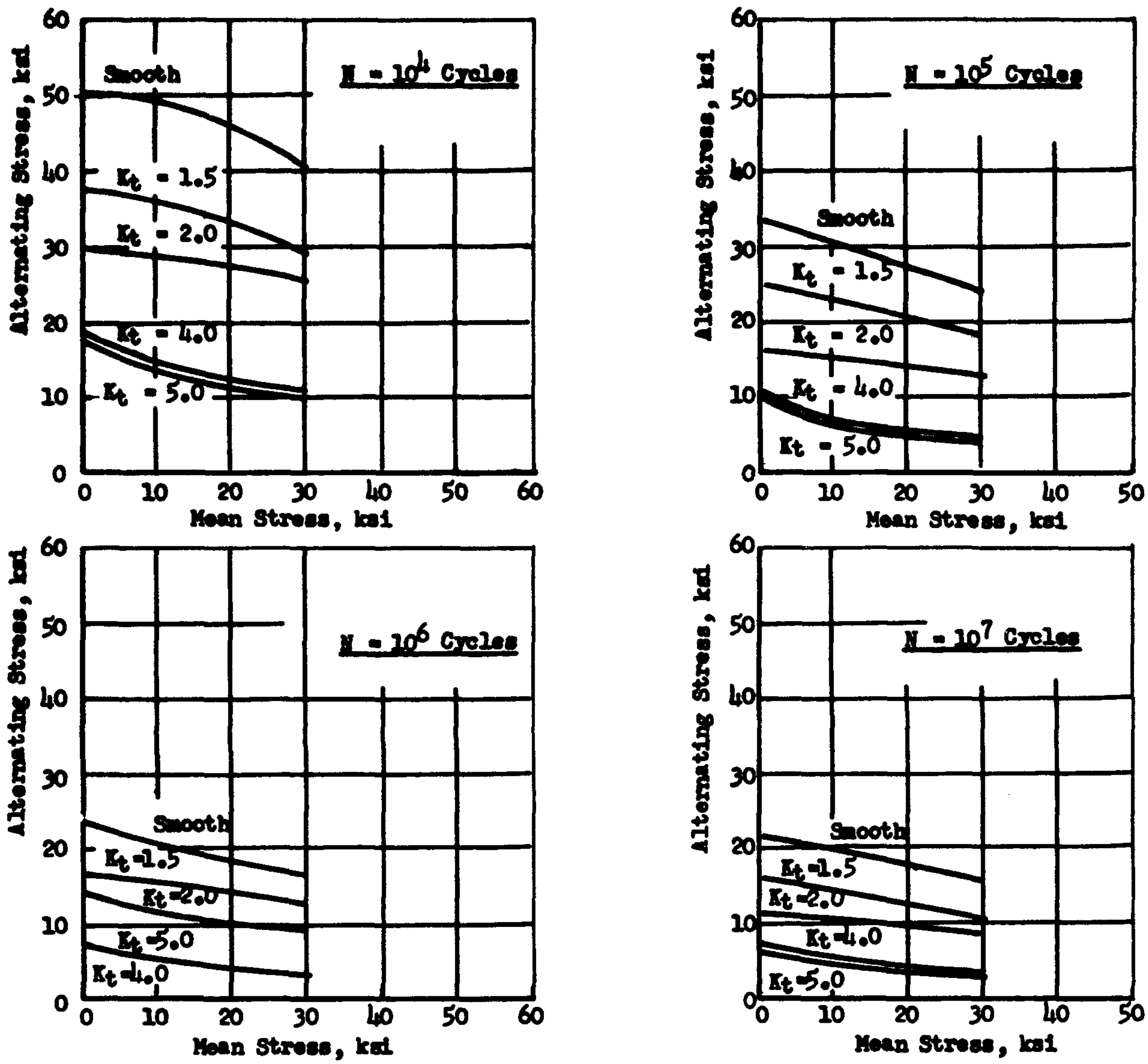

Fig. 101

Alternating vs. Mean Stress for 24S-T3

Aluminum Alloy Plate

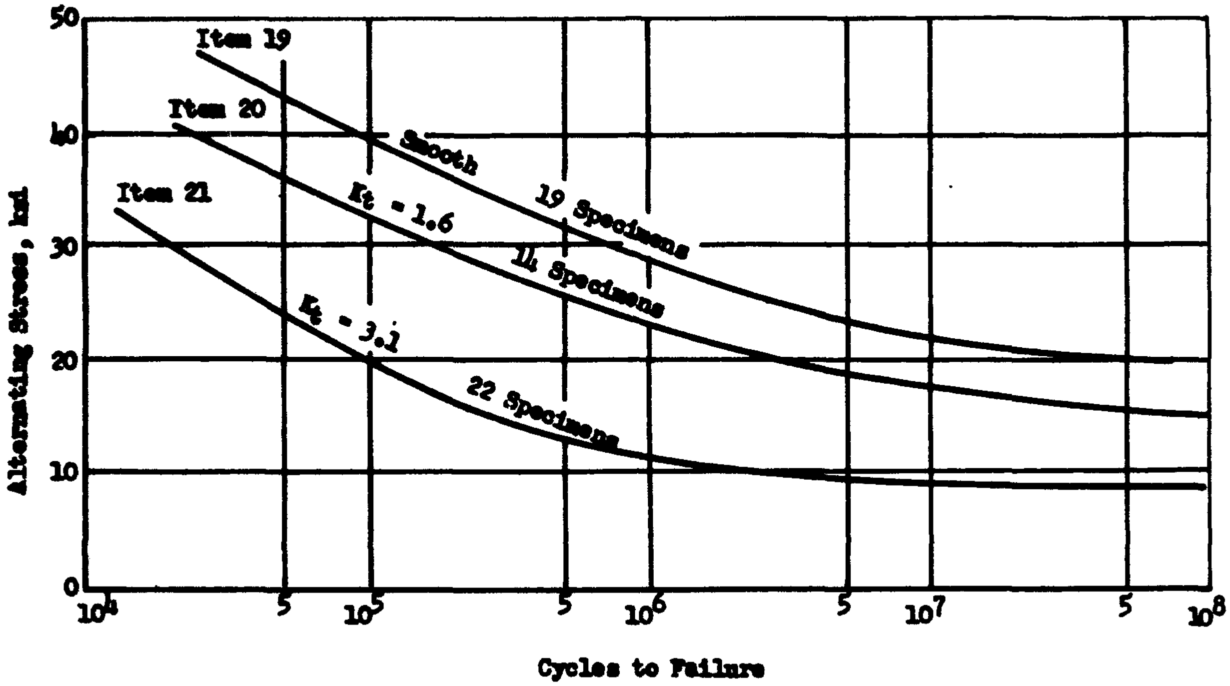

Fig. 102

S-N Curves for 24S-T4 Aluminum Alloy, Hot Rolled.

(From ref. 55)

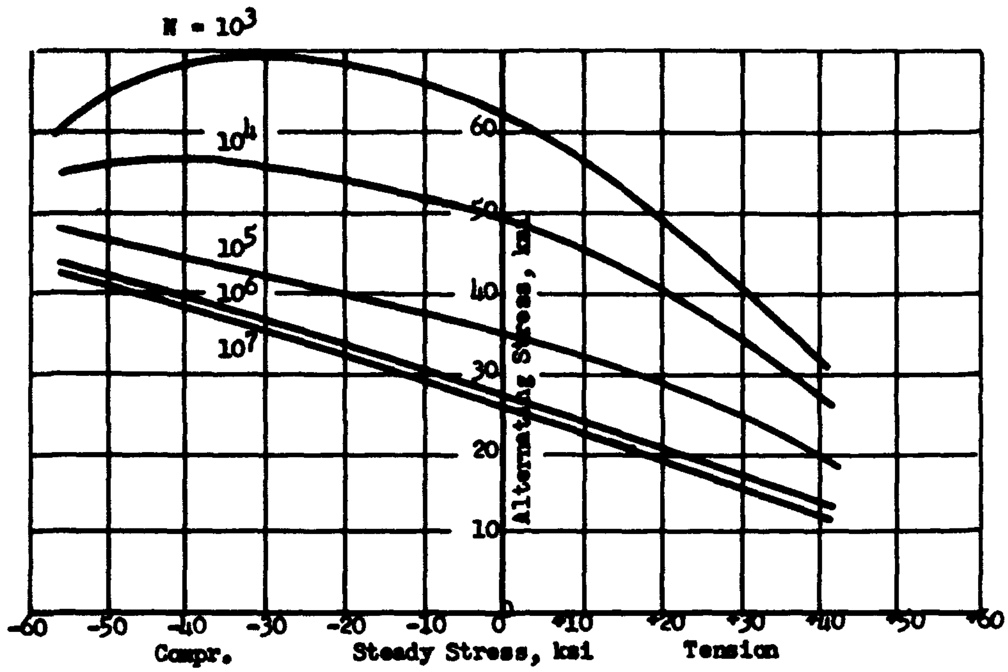

Fig. 103

Alternating vs. Steady Stress, for Aluminum Alloy 24S-T, Smooth

(Based on axial tests of 98 specimens)

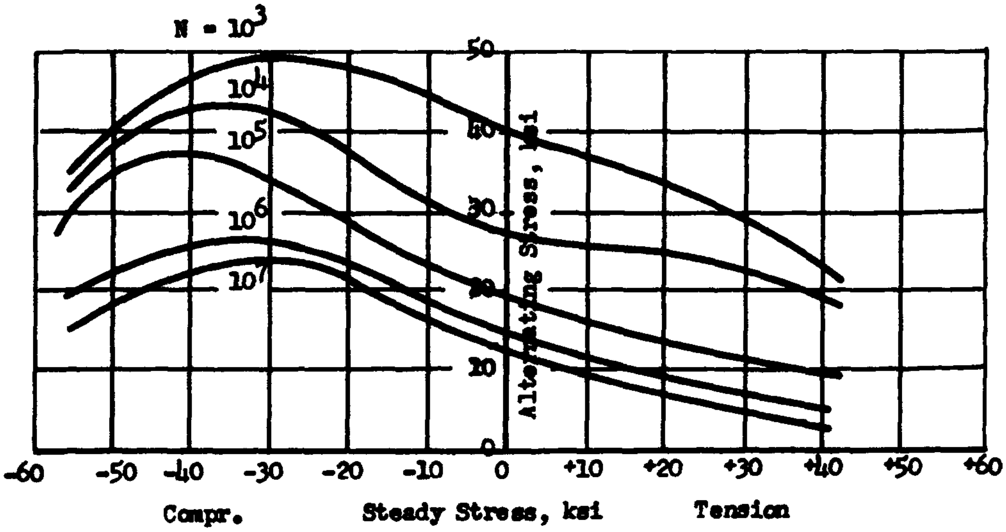

Fig. 104

Alternating vs. Steady Stress, for Aluminum Alloy 24S-T, Notched, K_t = 2.05

(Based on axial tests of 108 specimens)

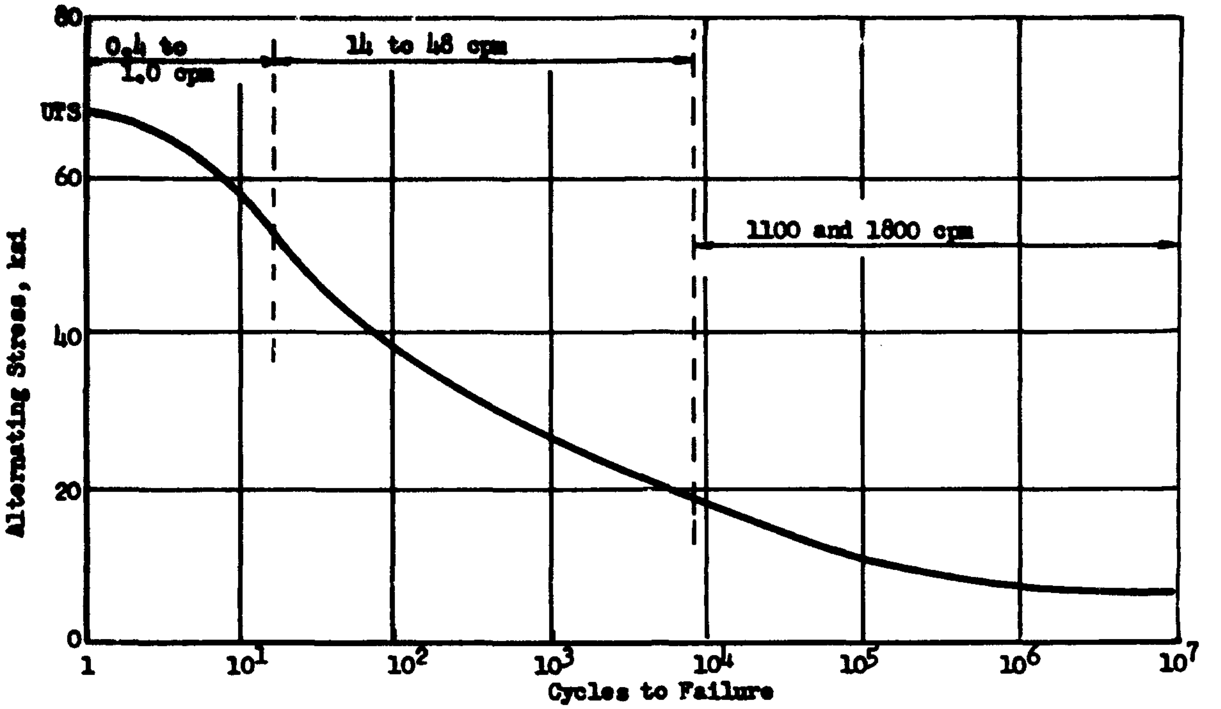

Fig.105

S-N Curve for 24S-T3, Axial Loads, Fully Reversed at Three Speeds, on Notched Specimens, $K_t = 4.0$

(From ref. 57)

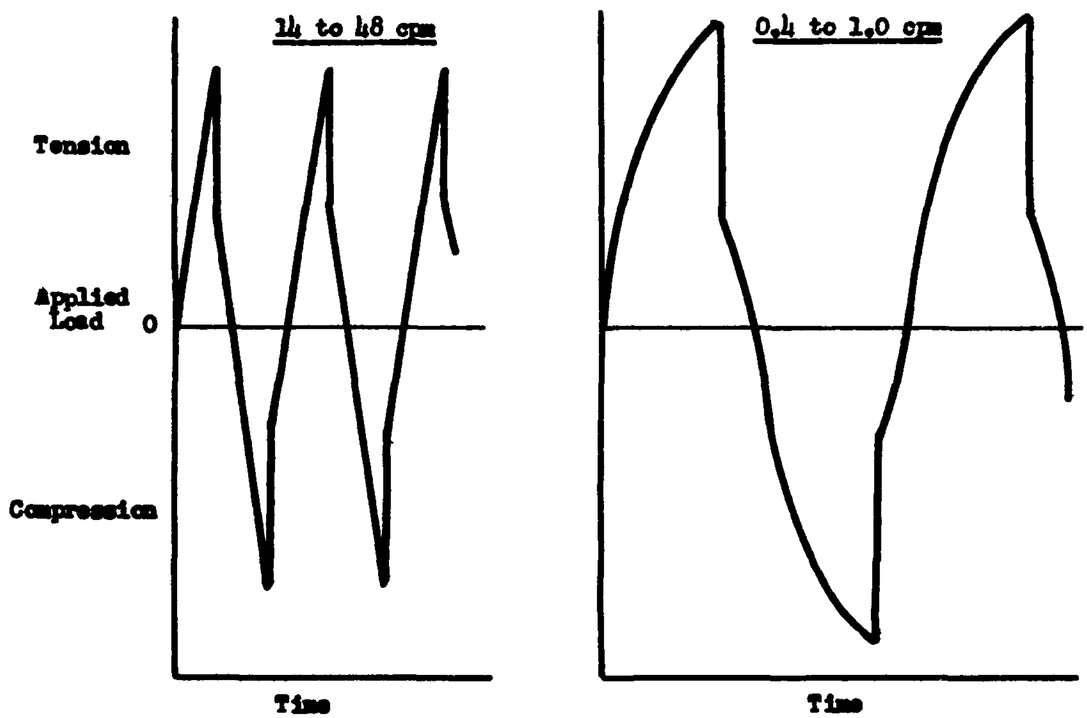

Fig.106

Typical Load-Time Curves for Part of S-N Curve on Fig.105

(From ref. 57)

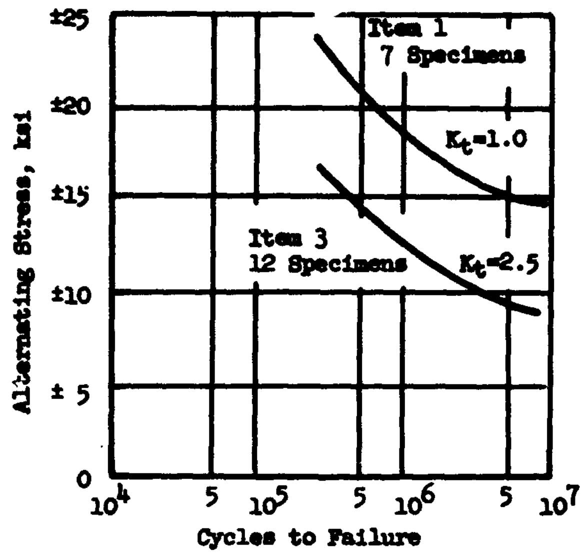

Fig. 107

S-N Curves for 61S-T6 Aluminum Alloy. Fully Reversed Stress (A = ∞)

(From Ref. 58)

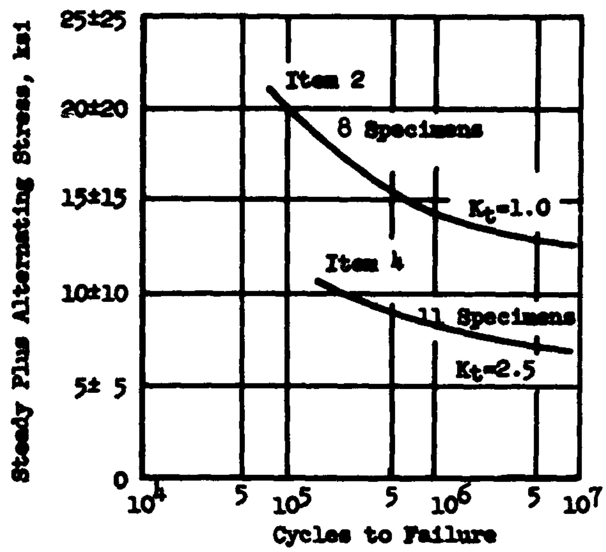

Fig. 108

S-N Curves for 61S-T6 Aluminum Alloy, For Steady Plus Alternating Stress (A = 1.0)

(From Ref. 58)

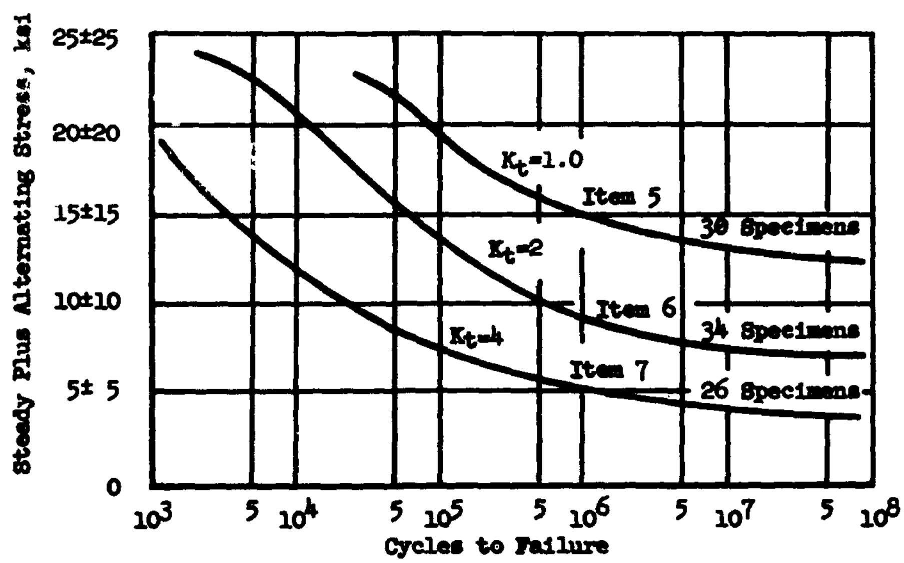

Fig. 109

S-N Curves for 61S-T6 Aluminum Alloy Sheet, For Steady Plus Alternating Stress (A = 1.0).

(From Ref. 45)

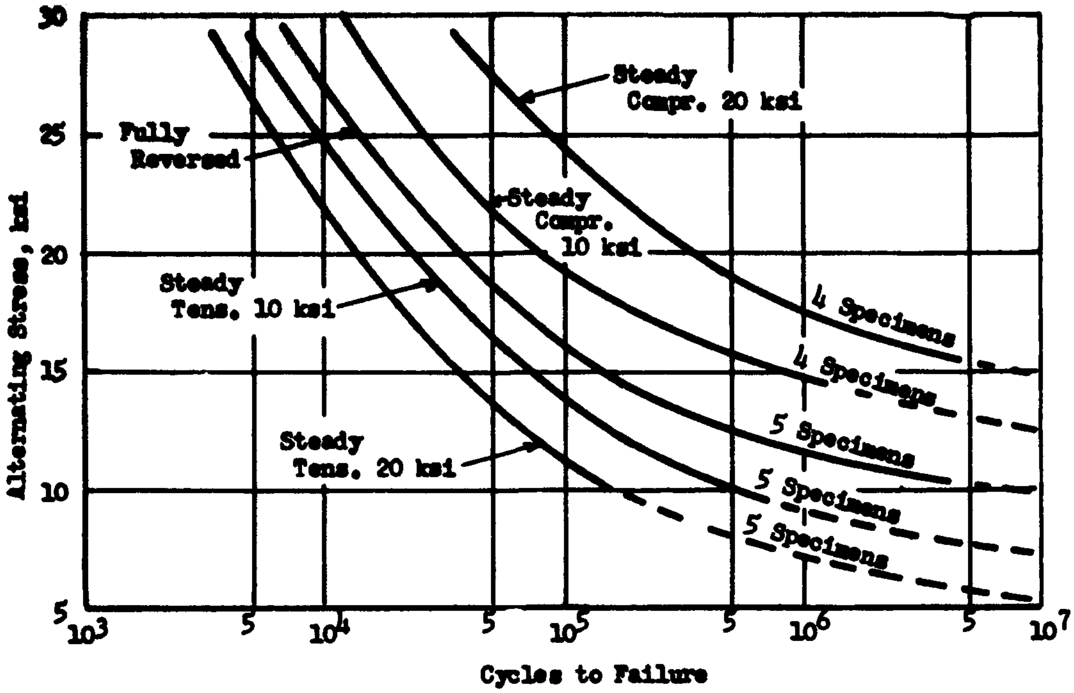

Fig.110

S-N Curves for Alclad 75S-T6, Notched, K_t = 2.5

(From ref. 51)

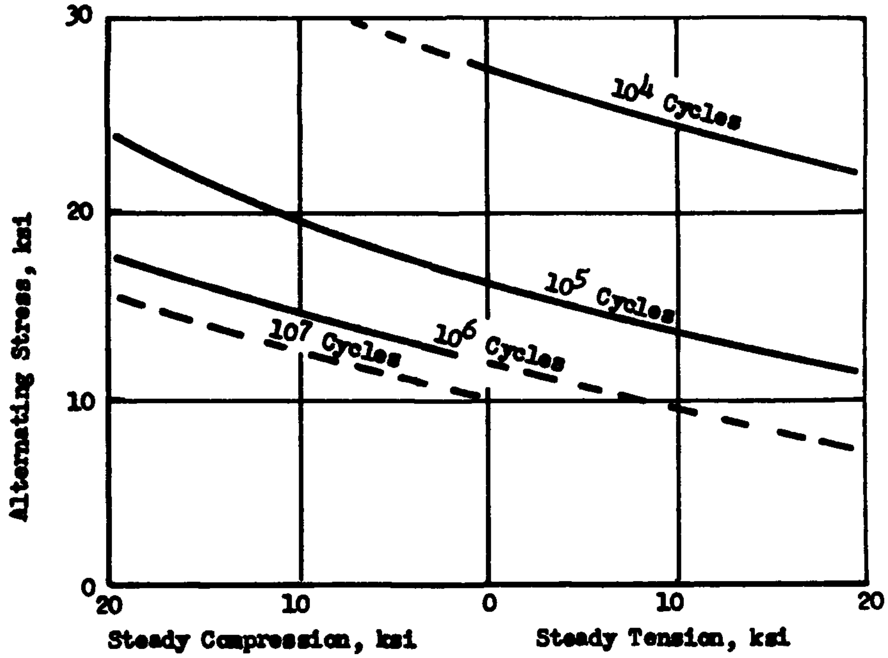

Fig.111

Alternating vs. Steady Stress for Alclad 75S-T6, Notched, K_t = 2.5

(From ref. 51)

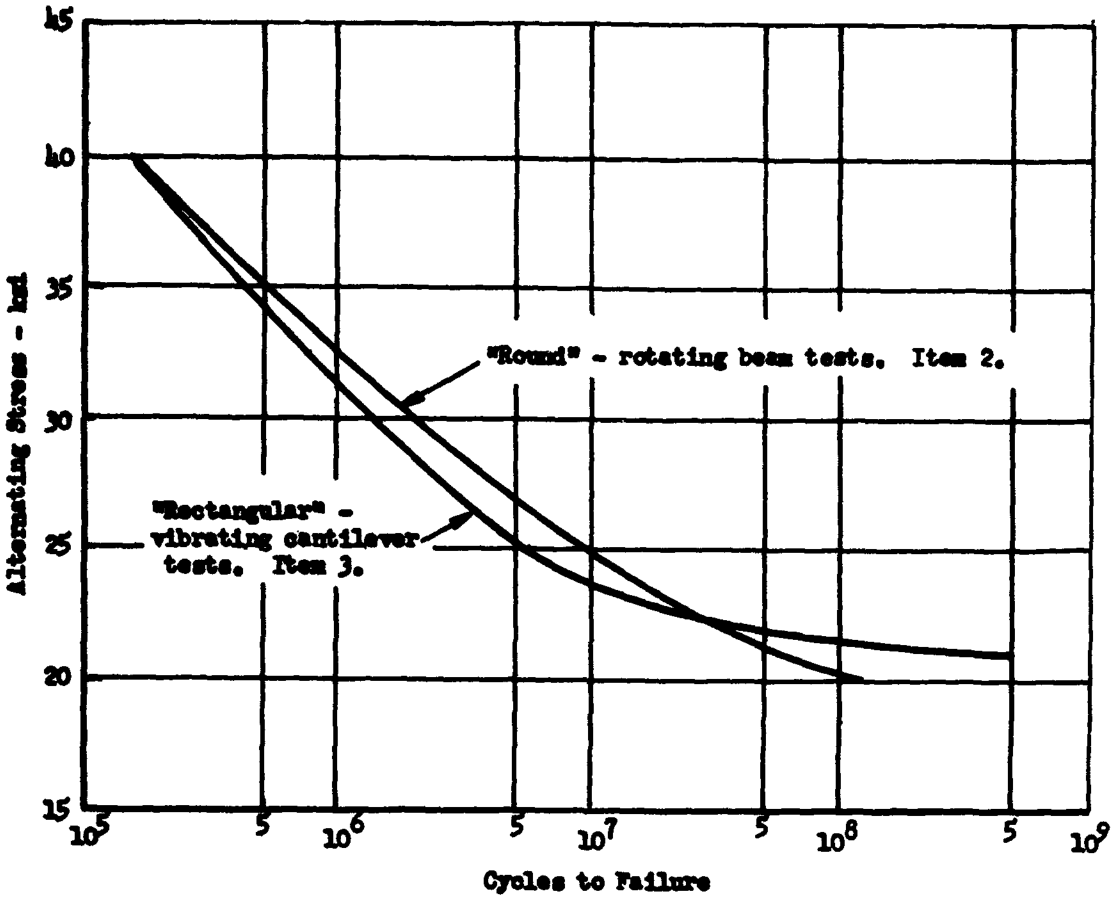

Fig.112

S-N Curves for Aluminum Alloy 75S-T, Extruded, Smooth Specimens

(From ref. 47)

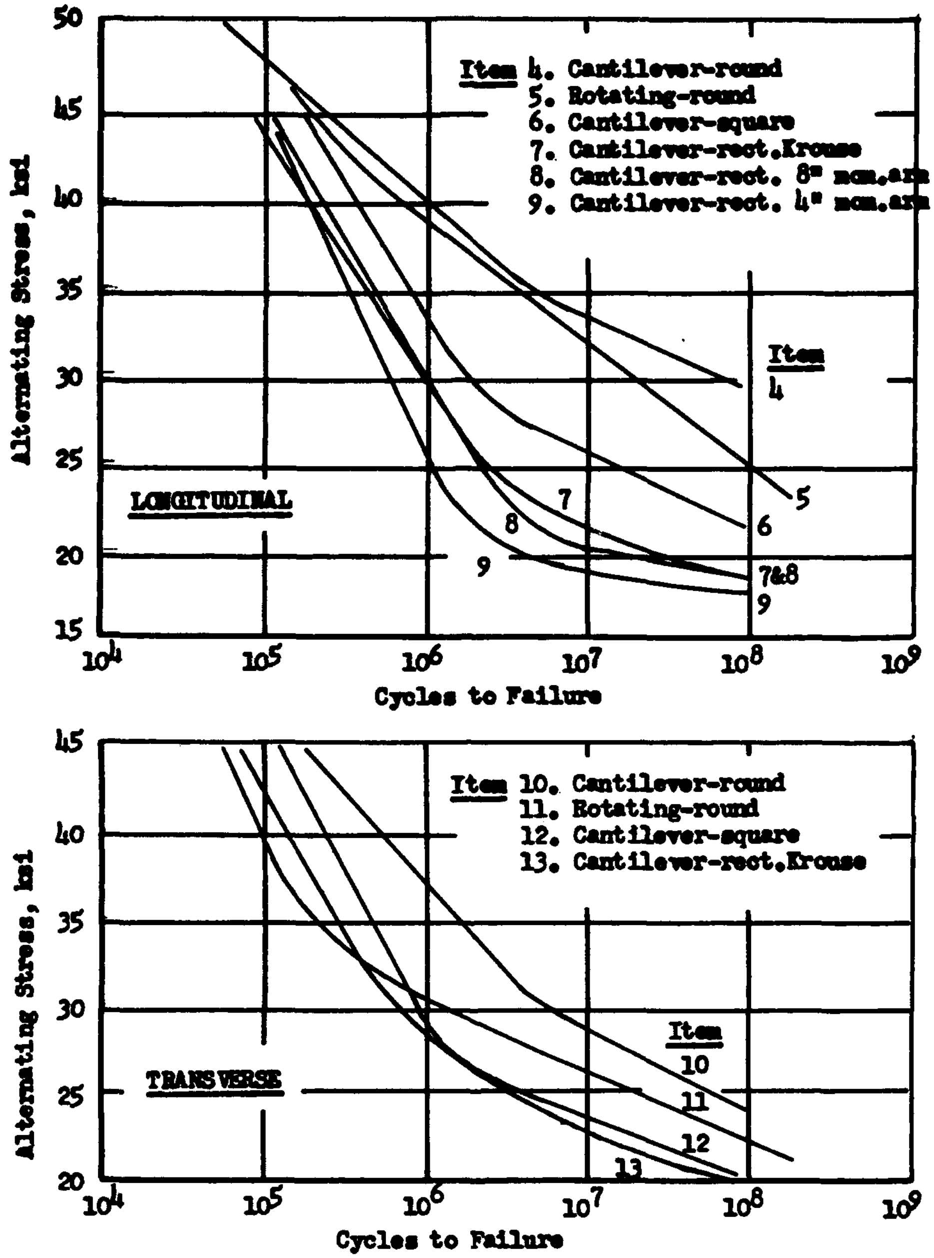

Fig. 113

S-N Curves for Aluminum Alloy 75S-T6, Rolled Plate, Smooth Specimens.

(From ref. 47)

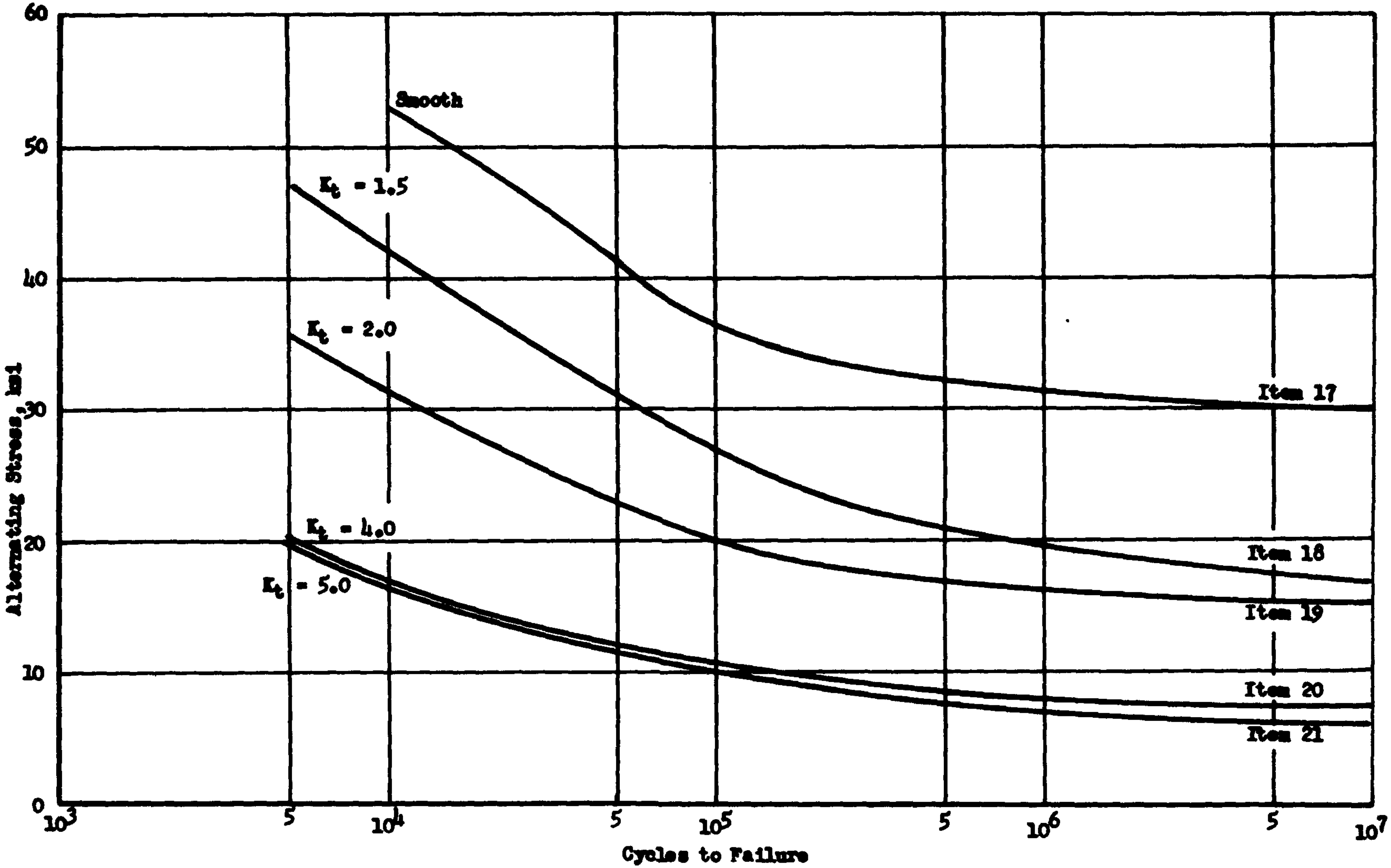

Fig. 114

S-N Curves for Aluminum Alloy 75S-T6, Plate.
Fully Reversed Axial Stress

(From ref. 10)

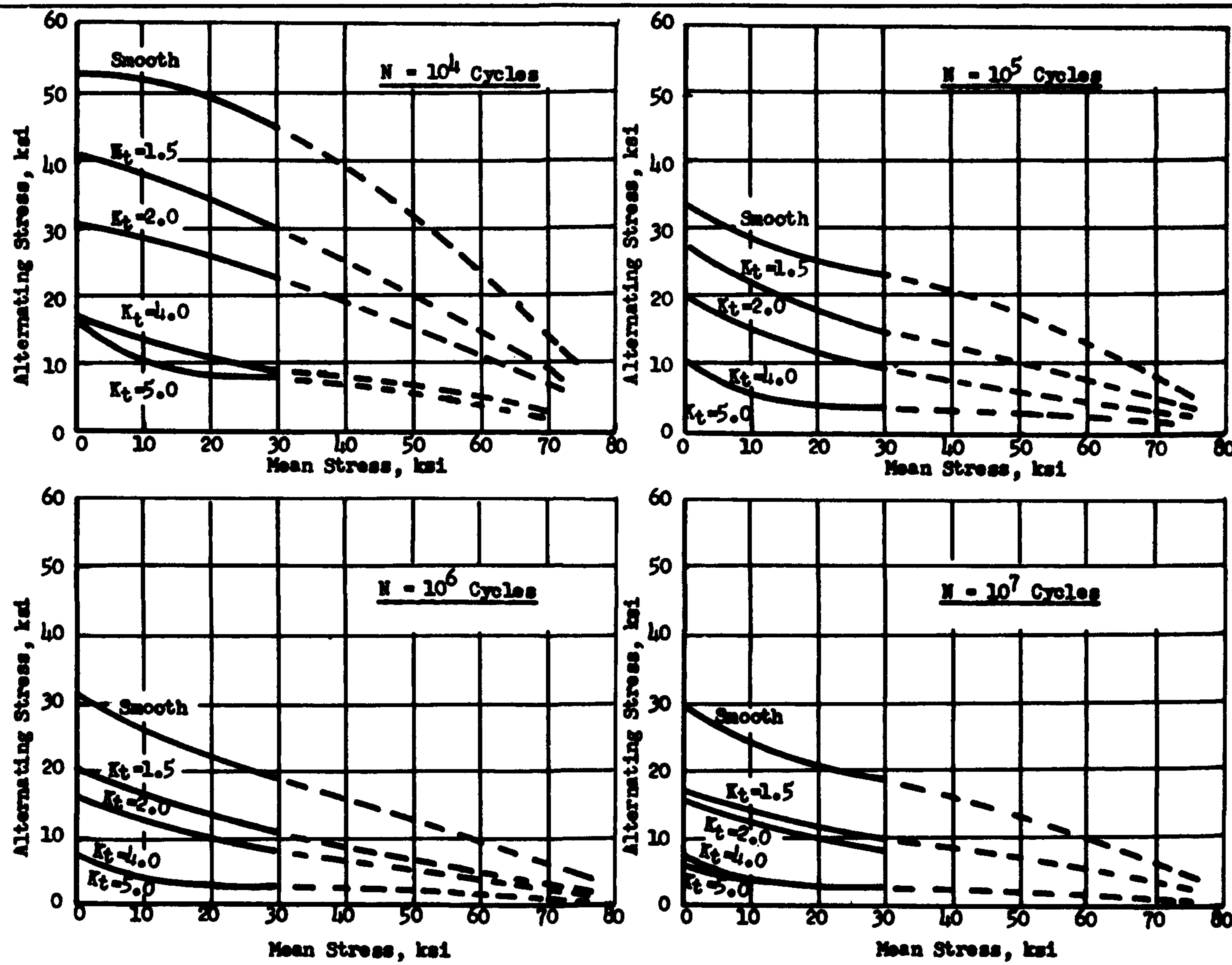

Fig.115

Alternating vs. Mean Stress, for Aluminum Alloy 75S-T6

Fully Reversed Axial Stress

(From refs. 9,10,53,54)

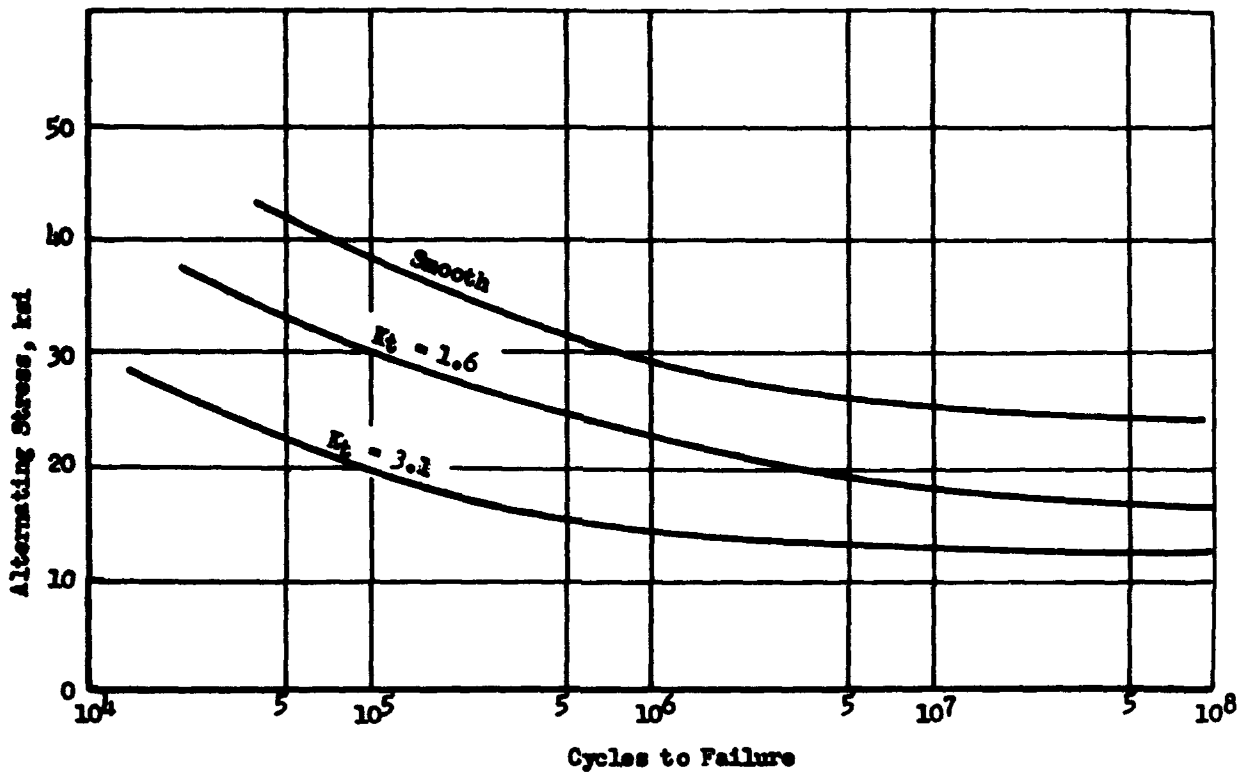

Fig. 116

S-N Curves for 75S-T6 Aluminum Alloy, Hot Rolled

(From ref. 55)

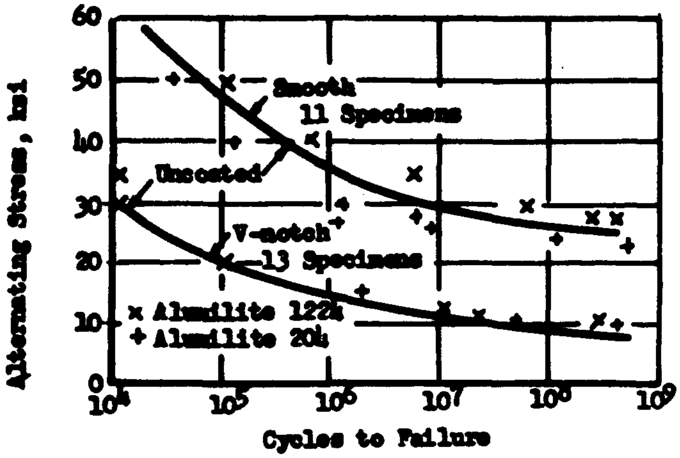

Fig. 117

S-N Curve, 75S-T6 Rolled and Drawn Rod, Smooth and Notched

(From ref. 59)

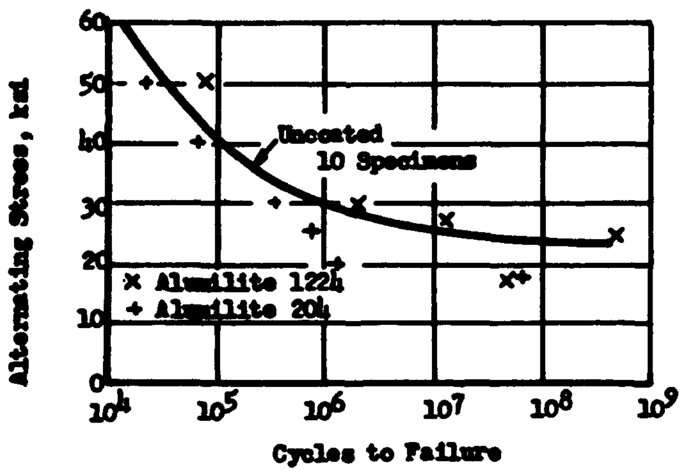

Fig. 118

S-N Curve, Extruded Bar 75S-T6, Smooth

(From ref. 59)

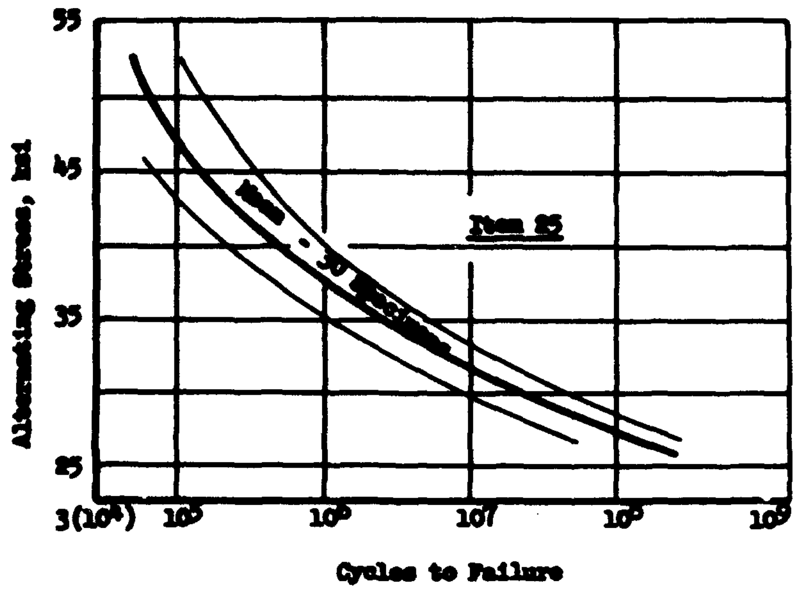

Fig. 119

S-N Curve for 75S-T Aluminum Alloy, Showing Mean, and Scatter Band

(From Ref. 23)

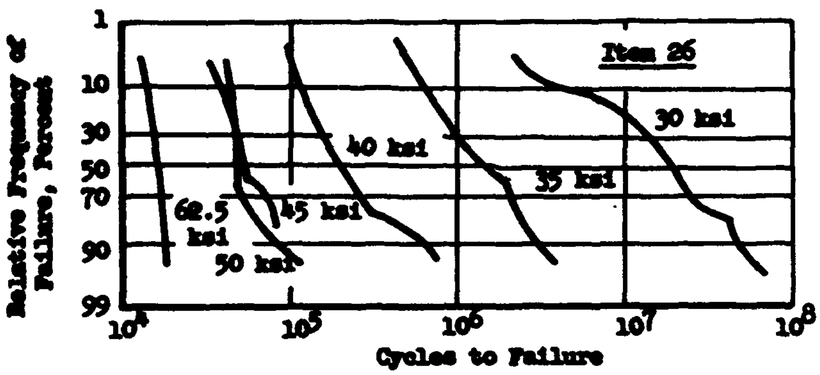

Fig. 120

Log-Probability Diagram Showing Fatigue Life-Times, of Different Stresses, for 75S-T6 Aluminum Alloy

(From Ref. 60)

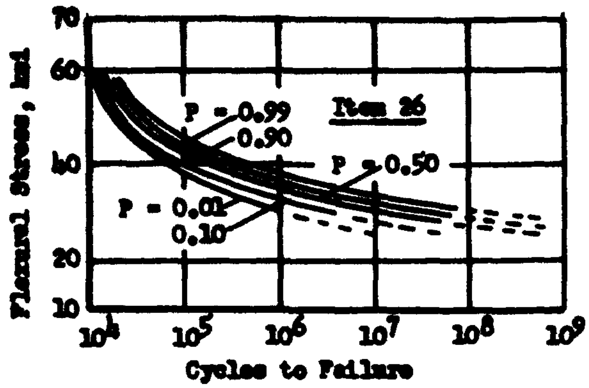

Fig. 121

S-N Curves for 75S-T6 Aluminum Alloy, for Various Probabilities of Failure.

(From ref. 60)

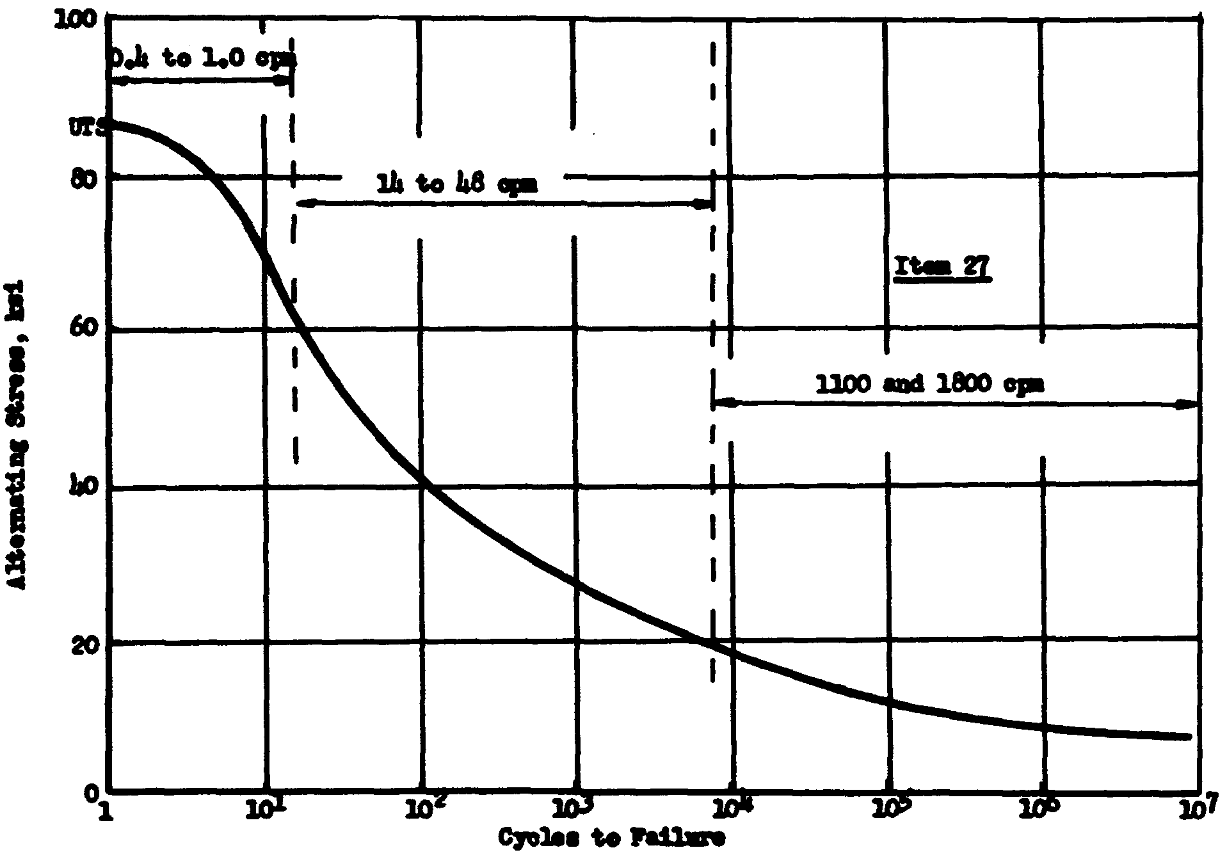

Fig. 122

S-N Curve for 75S-T6 Aluminum Alloy, for Axial Loads, Fully Reversed, on Notched Specimens. $K_t = 4.0$

(From ref. 57)

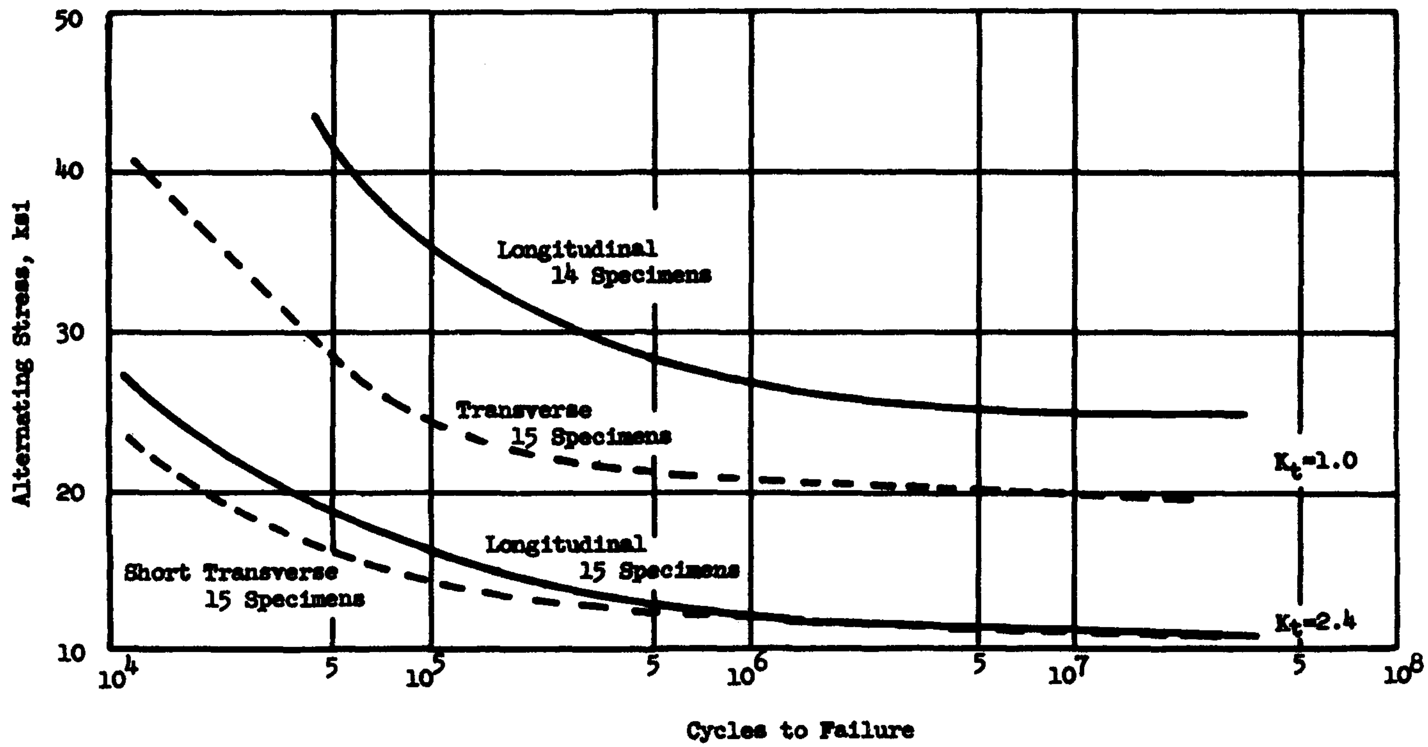

Fig. 123

S-N Curves for 7075-T6 Aluminum Alloy, Hand Forged. Longitudinal, and Short Transverse, Axial Tests

(From Ref. 49)

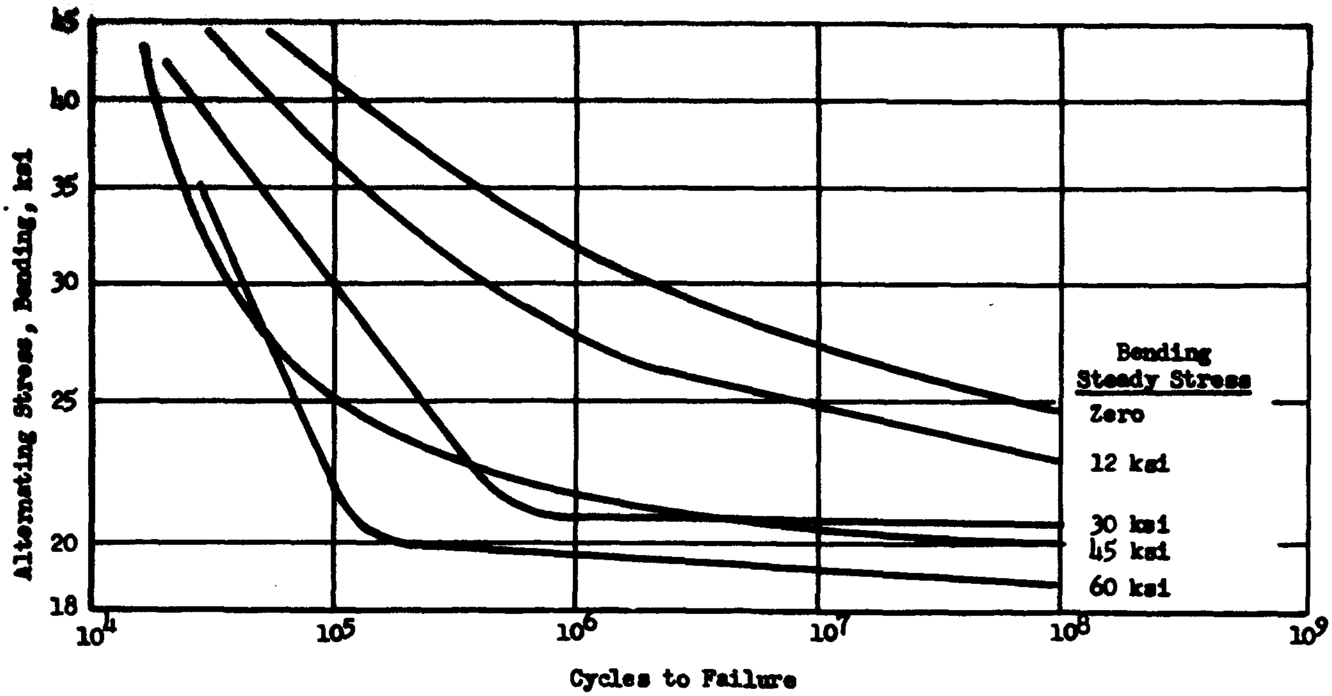

Fig.124

S-N Curves for 76S-T61 Aluminum Alloy-Alternating Bending Stress Superimposed on the Indicated Steady Bending Stress.

(From Ref. 61)

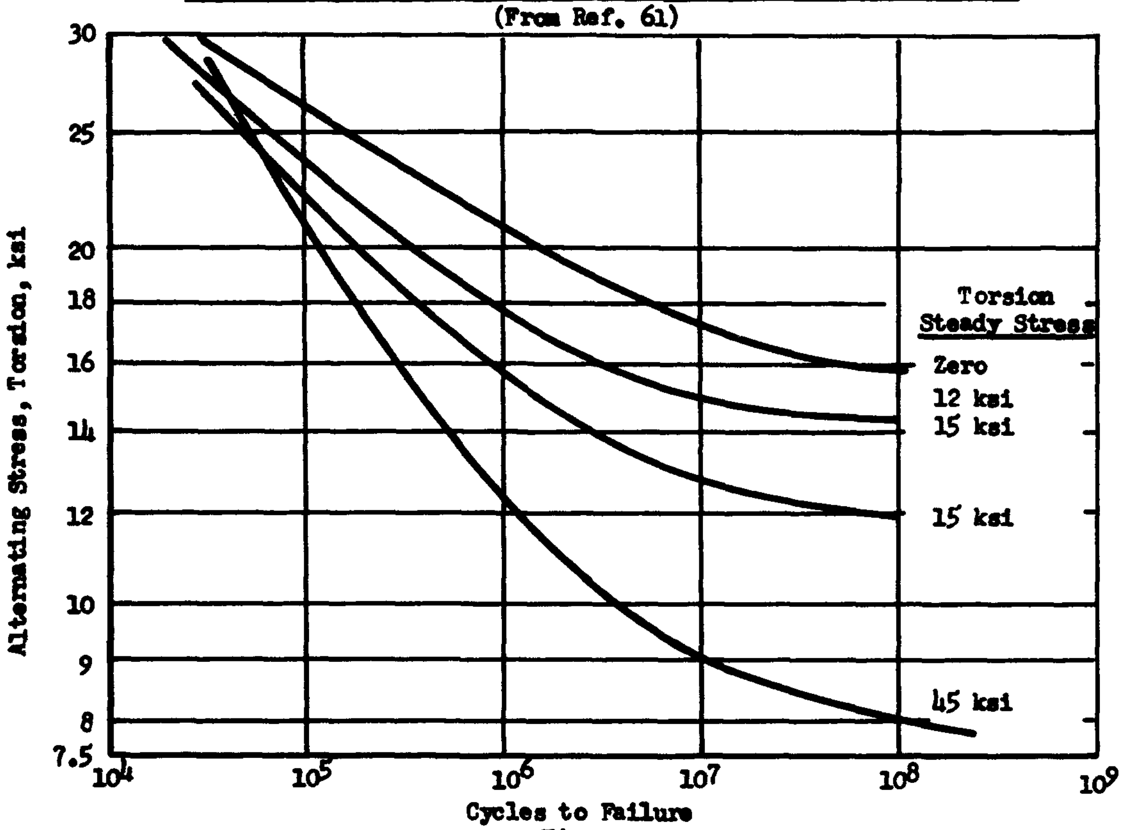

Fig. 125

S-N Curves for 76S-T61 Aluminum Alloy-Alternating Torsion Stress Superimposed on Steady Torsion Stress.

(From ref. 61)

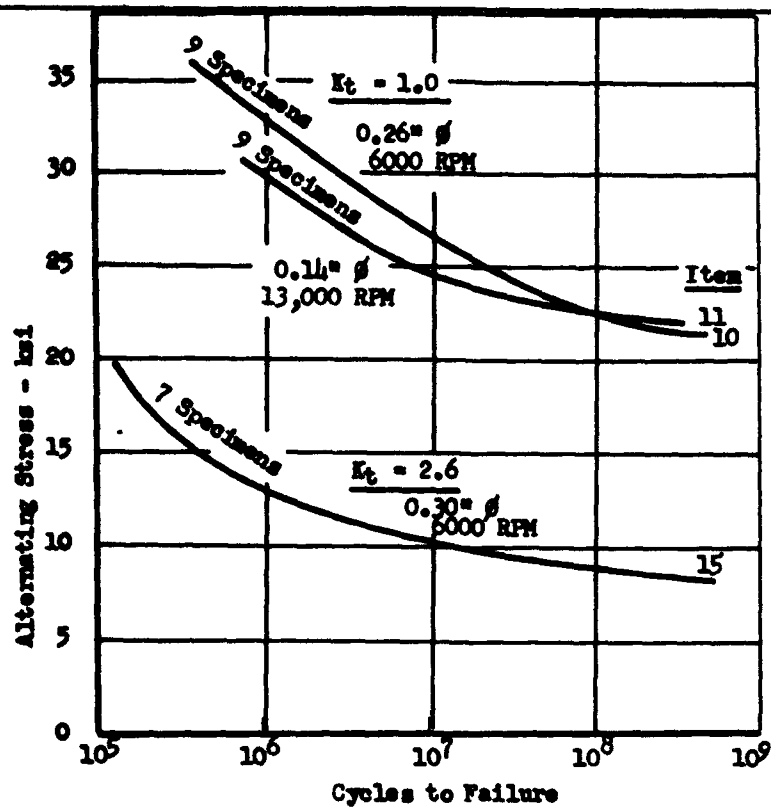

Fig.126

S-N Curves for Aluminum Alloy X76S-T. Rotating Bending Tests.

(From ref. 62)

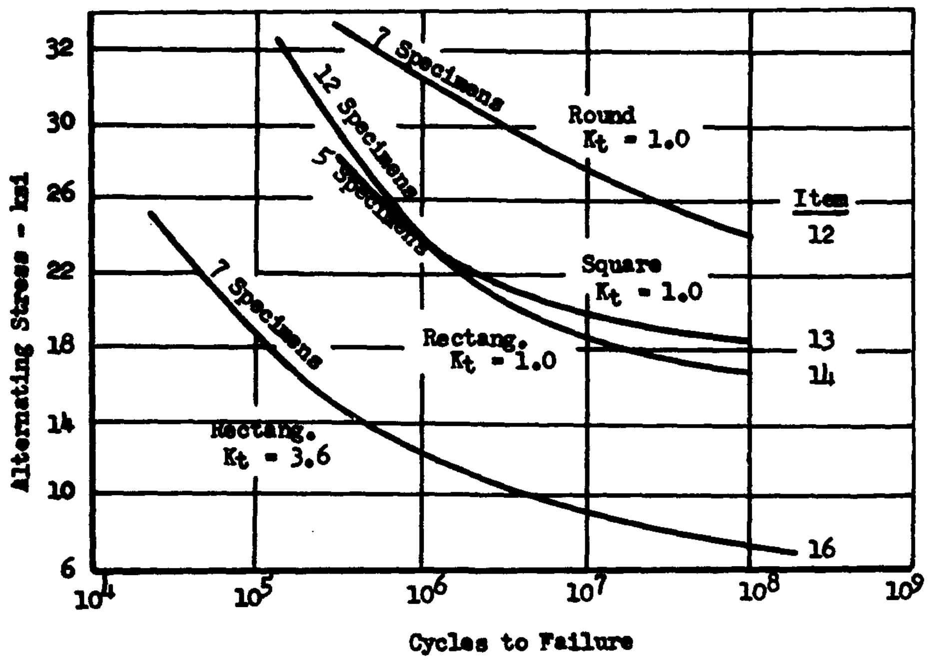

Fig.127

S-N Curves for Vibratory Reversed Bending of X76S-T Aluminum Alloy

(From ref. 62)

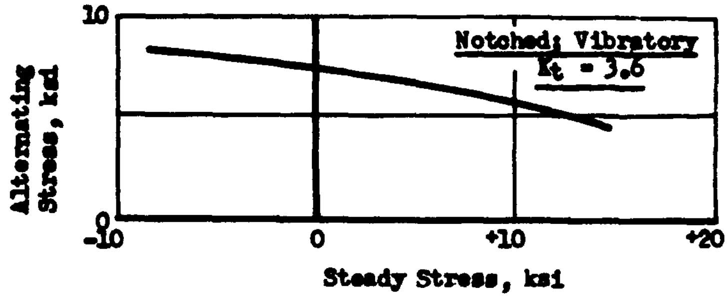

Fig.128

Alternating Stress vs. Steady Stress, for Notched X76S-T Aluminum Alloy. K_t = 3.6

(From ref. 62)

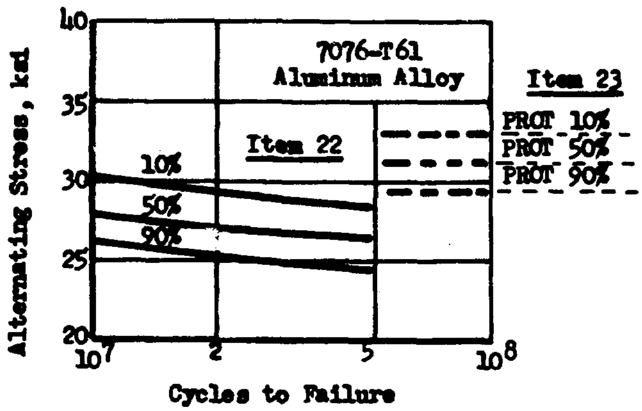

Fig.129

S-N Curves for Aluminum Alloy 7076-T61.
10, 50, and 90% Probability of Survival of Stress at Constant Life

(From ref. 29)

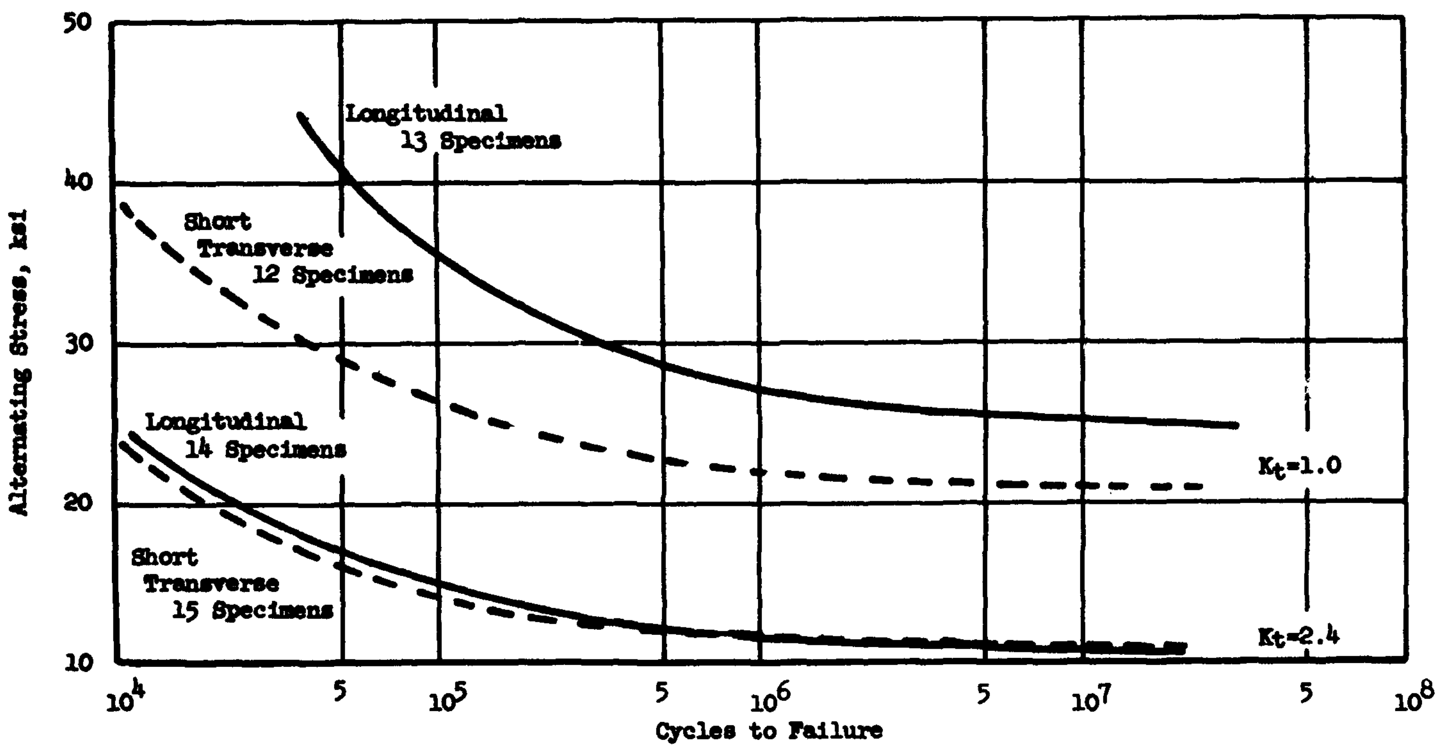

Fig. 130

S-N Curves for 7079-T6 Aluminum Alloy, Hand Forged. Longitudinal, and Short Transverse, Axial Tests

(From Ref. 49)

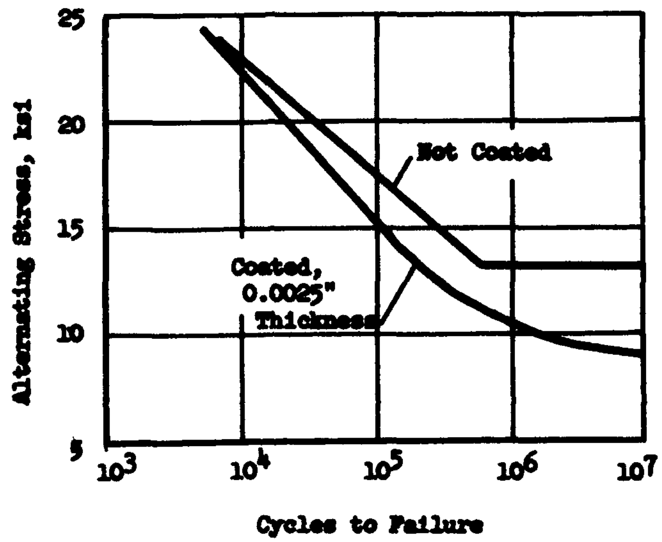

Fig.131

S-N Curves for Magnesium Alloy AZ31X, Not Coated, and Coated Anodically to 0.0025 inch Thickness

(From ref. 63)

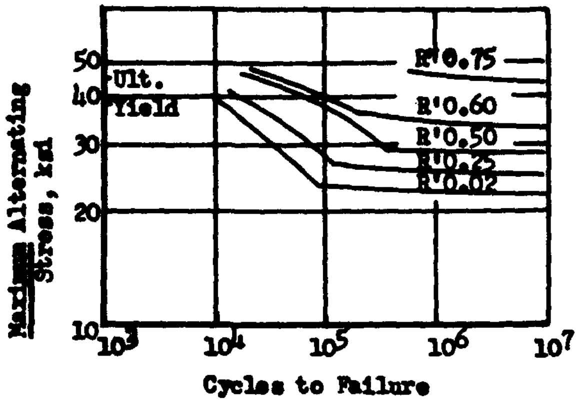

Fig. 132

S-N-R Curves for Magnesium Alloy FS-1h, Smooth.

(From ref. 65)

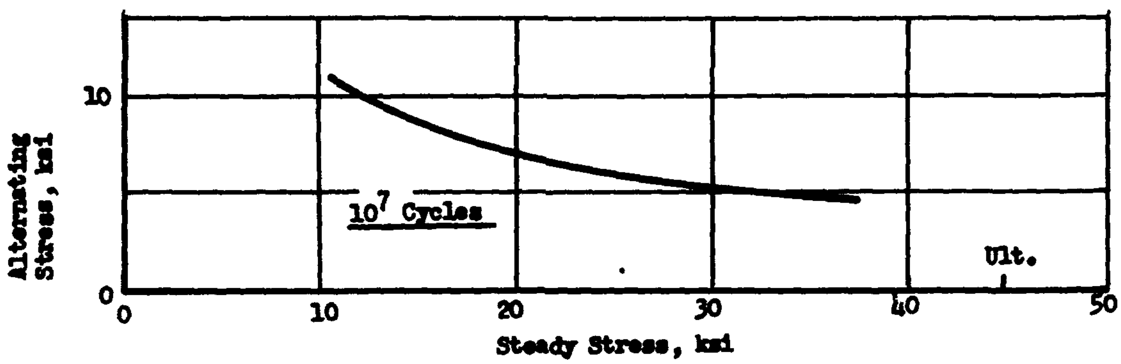

Fig. 133

Steady Stress vs. Alternating Stress for Magnesium Alloy FS-1h, Smooth Sheet, for N = 10^7 Cycles.

(Derived from Fig.132)

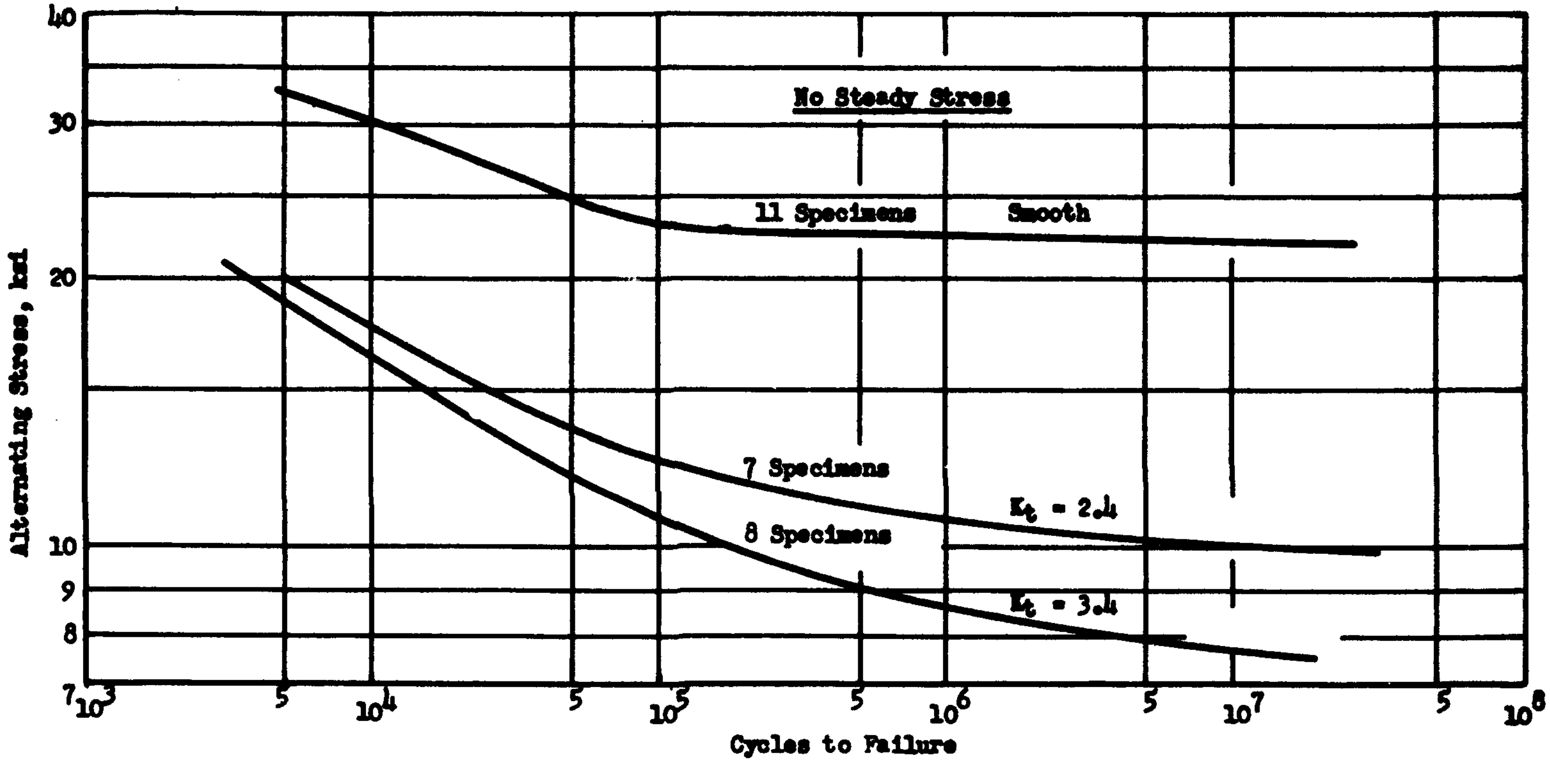

Fig. 134
S-N Curves for Extruded Magnesium Alloy ZK60A-T5
(From ref. 66)

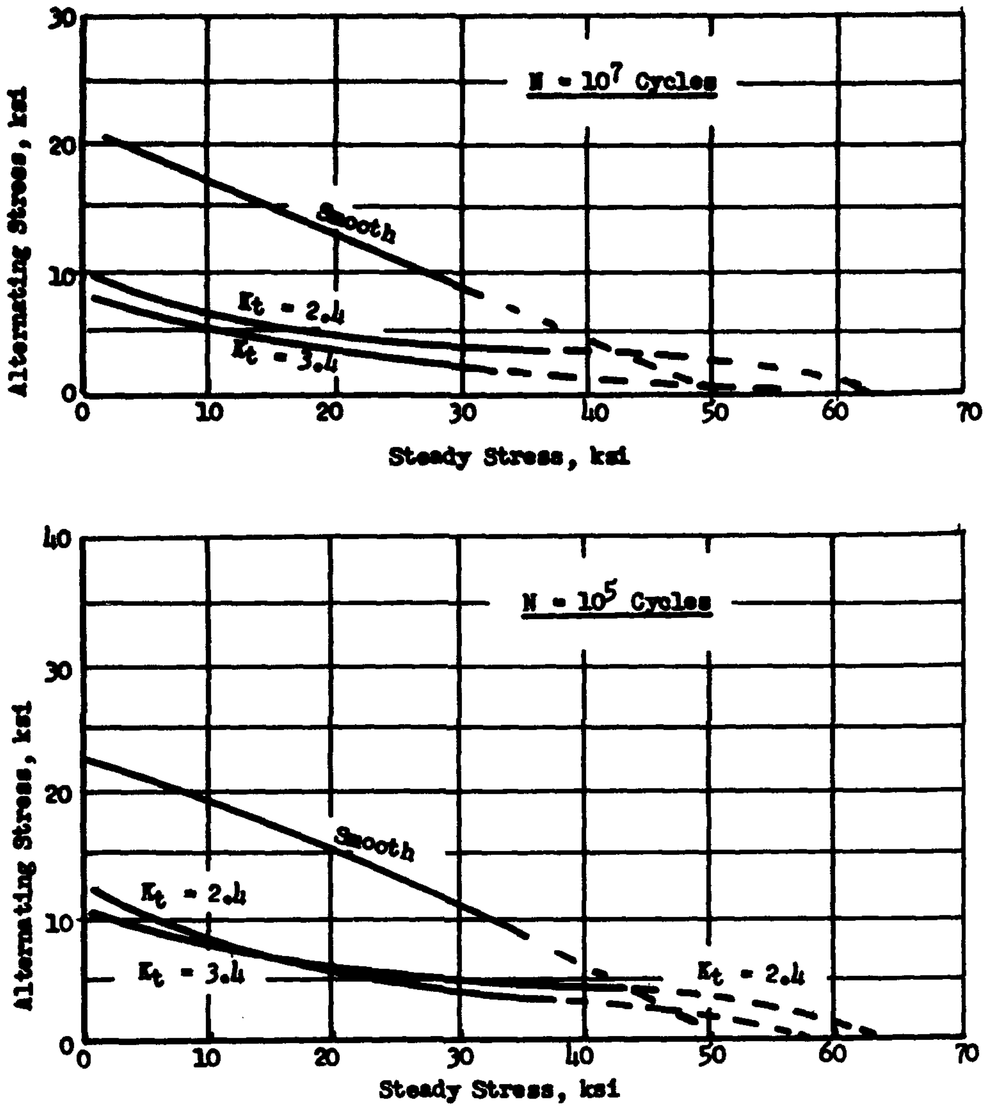

Fig. 135

Alternating Stress vs. Steady Stress for Extruded Magnesium Alloy ZK60A-T5, for N = 10^7 and 10^5 Cycles

(From ref. 66)

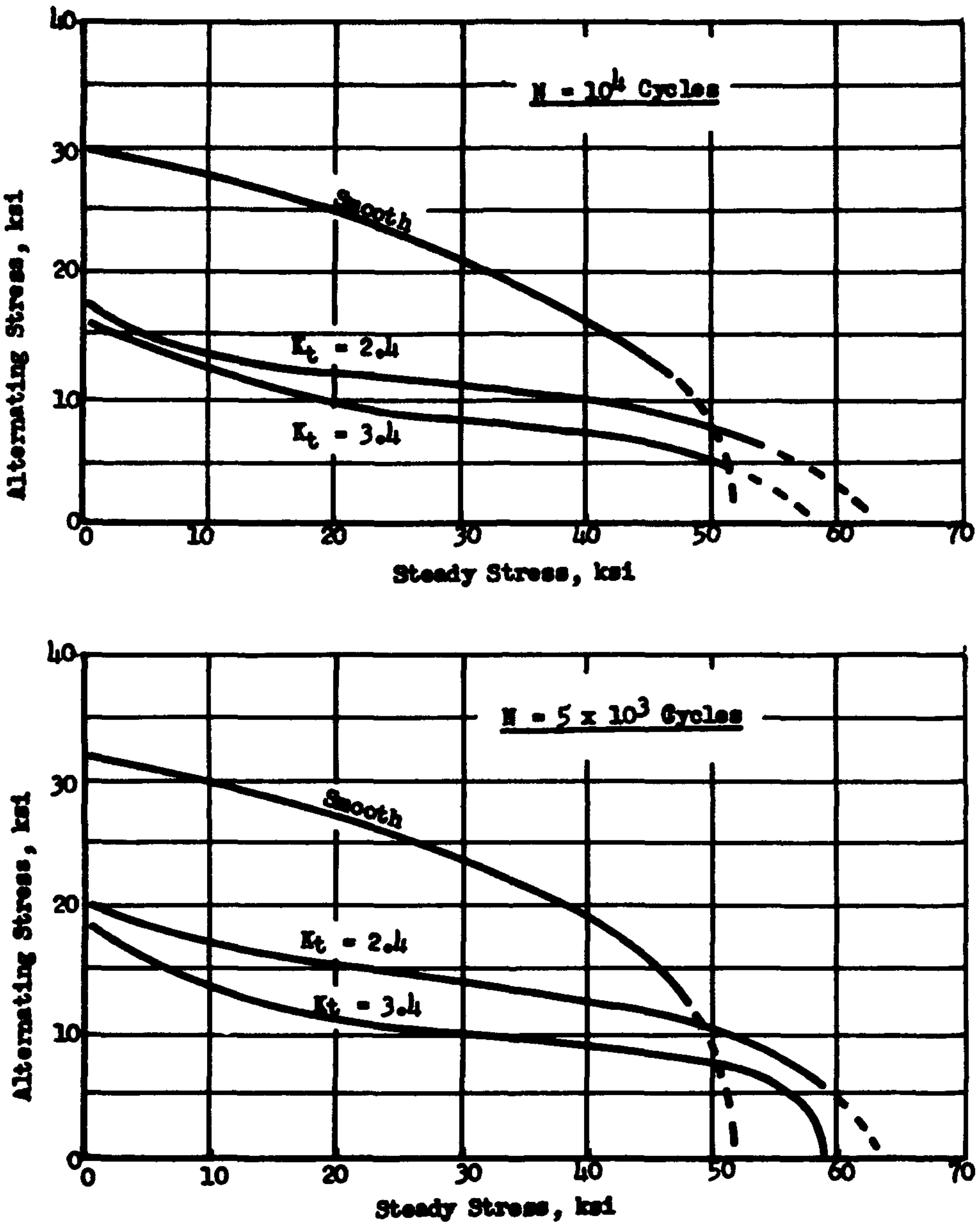

Fig. 136

Alternating Stress vs. Steady Stress for Extruded Magnesium Alloy ZK60A-T5, for N = 10^4 and $5(10^3)$ Cycles

(From ref. 66)

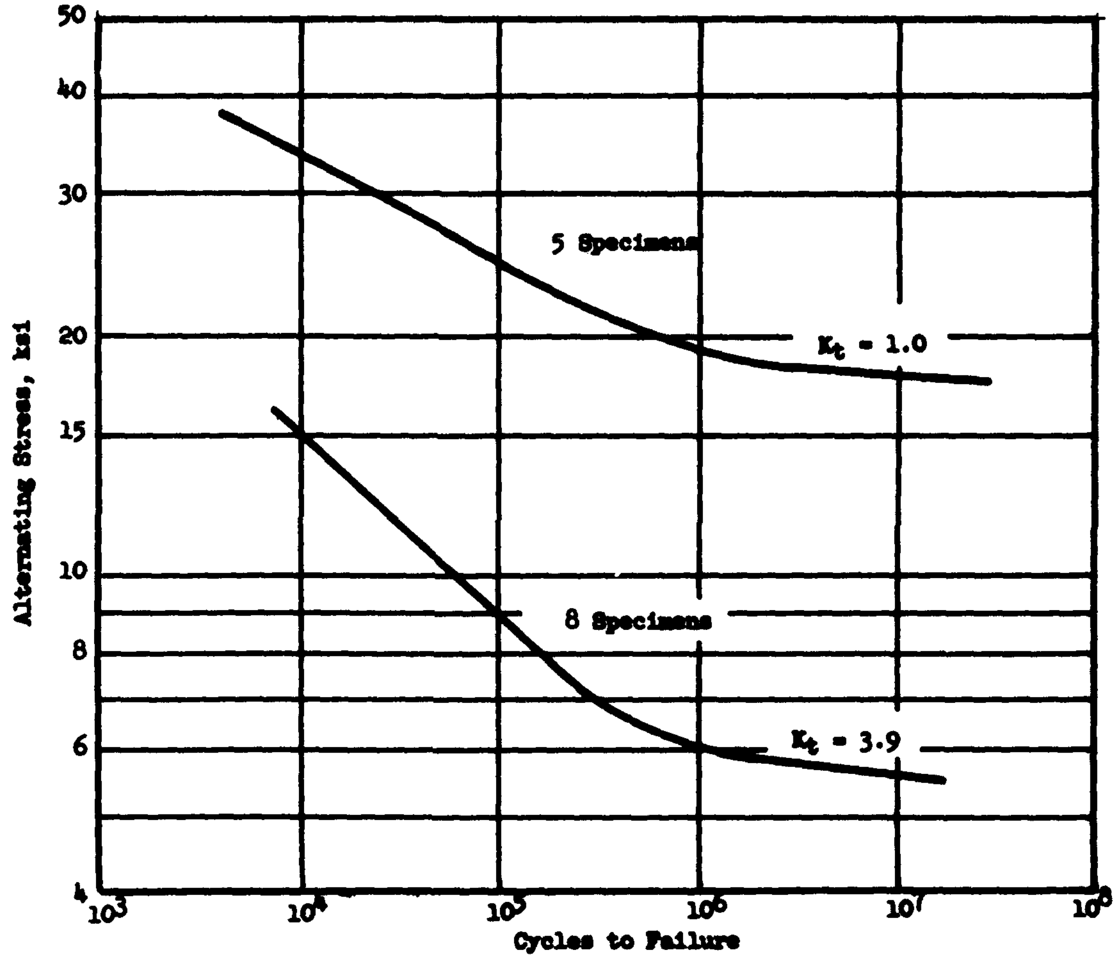

Fig. 137

S-N Curves for Magnesium Alloy J-1

(From Ref. 4)

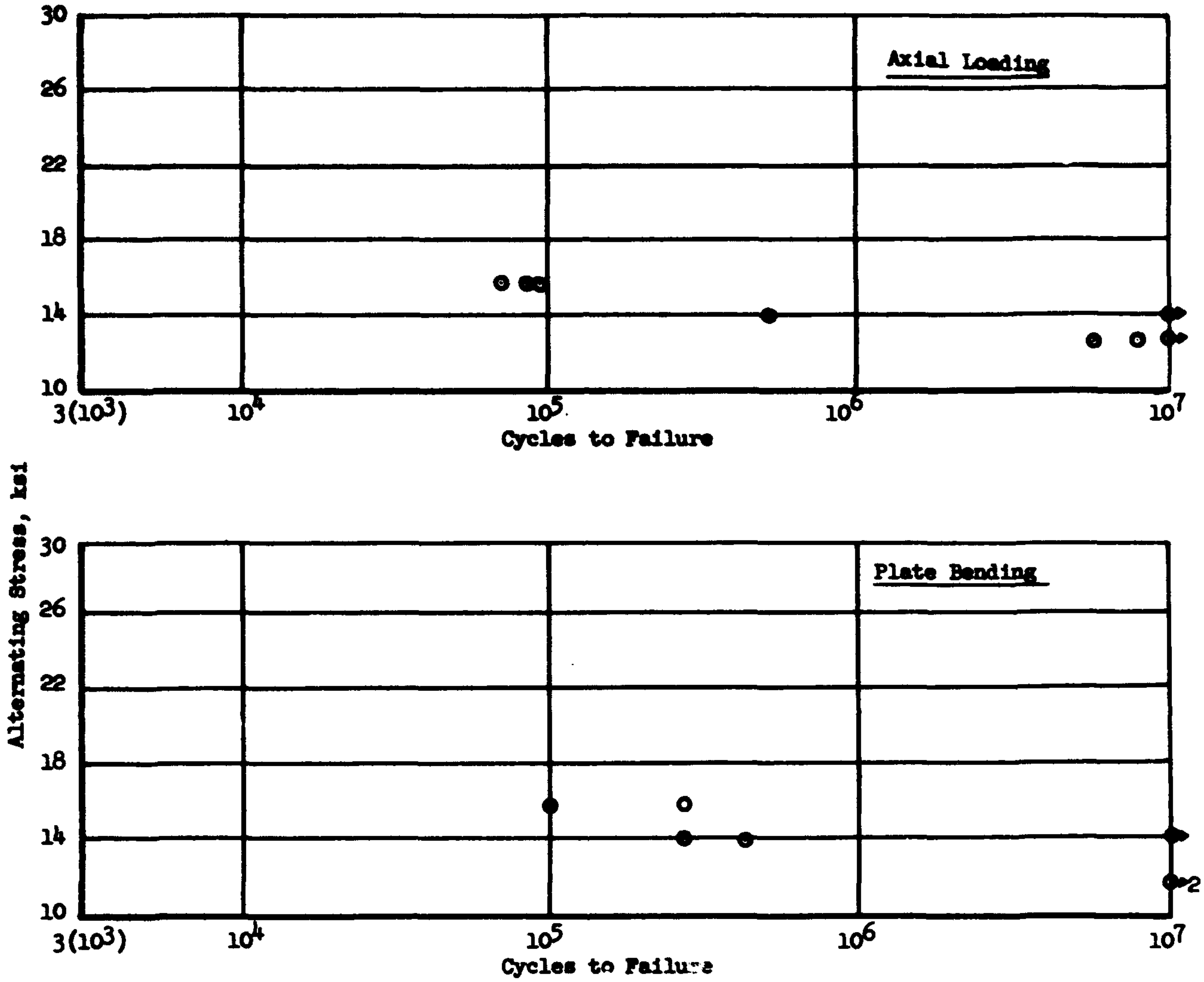

Fig. 138

S-N Plot of Fatigue Tests of FS-1a (AZ31A-O) Magnesium Alloy

(From Ref. 67)

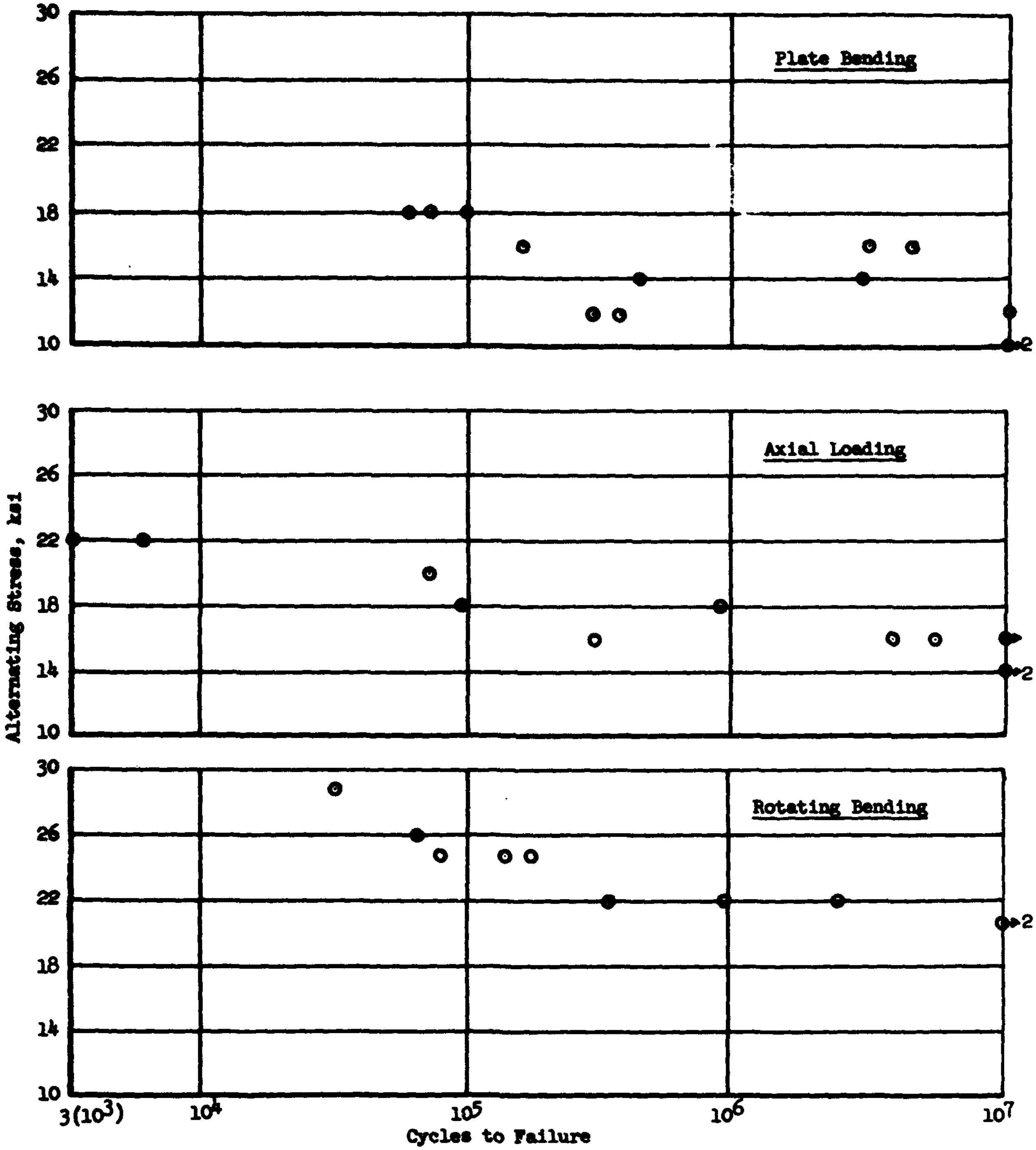

Fig. 139

S-N Plot of Fatigue Tests of J-1 (AZ61A-F) Magnesium Alloy

(From Ref. 67)

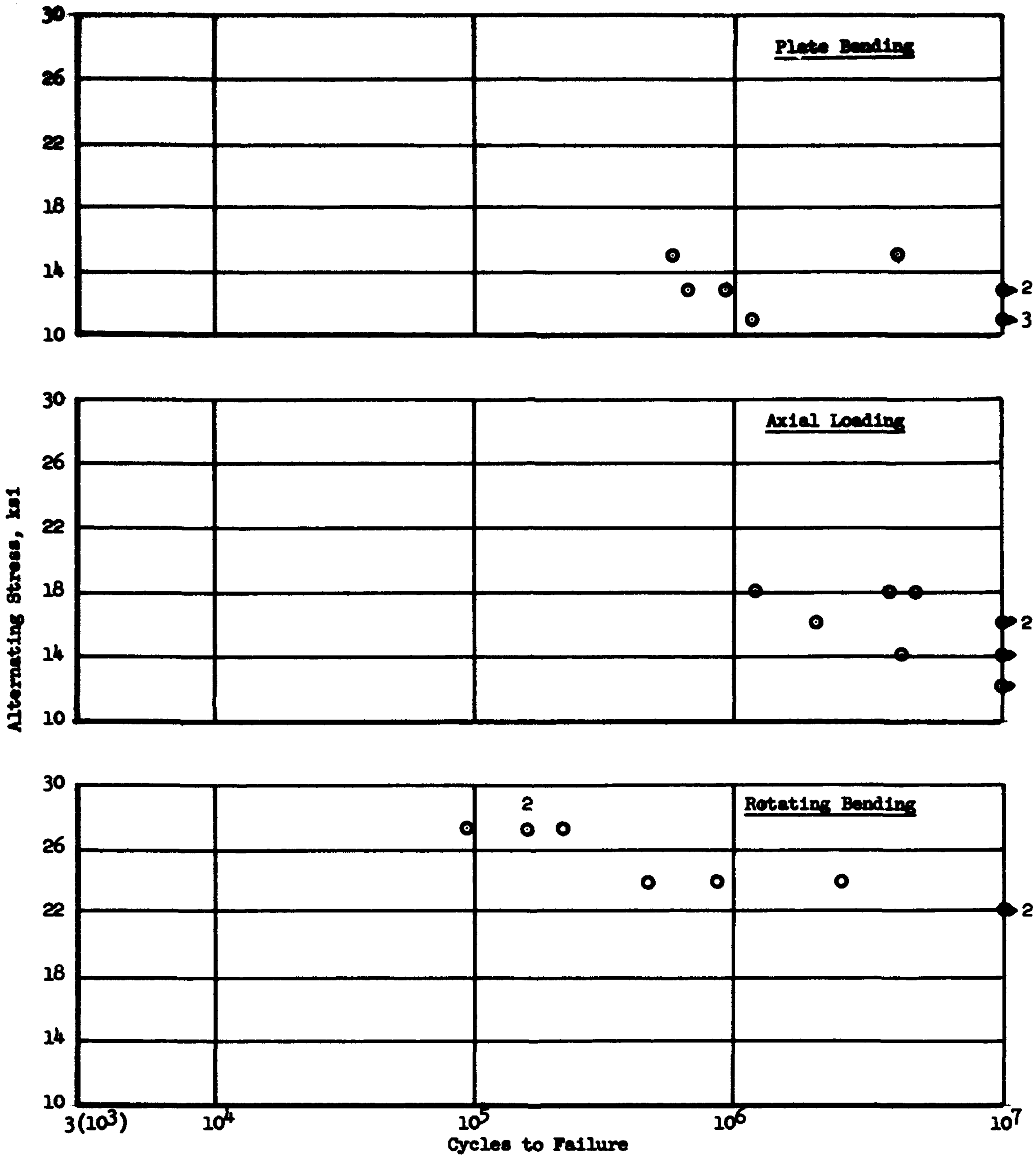

Fig. 140

S-N Plot of Fatigue Tests of O-1 (AZ80A-F) Magnesium Alloy

(From Ref. 67)

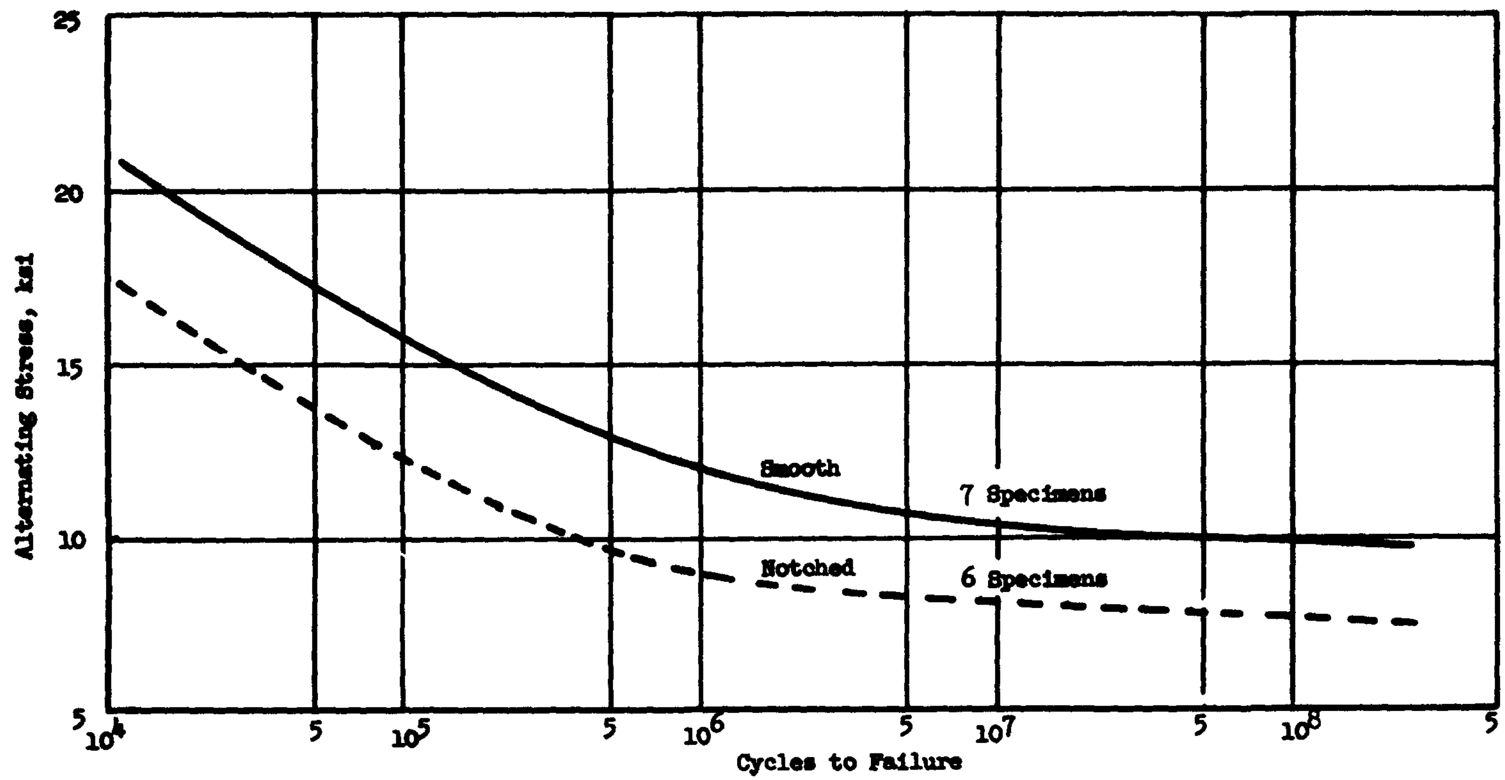

Fig. 141

S-N Curves for AZ-81T4 Magnesium Alloy

(From Ref. 68)

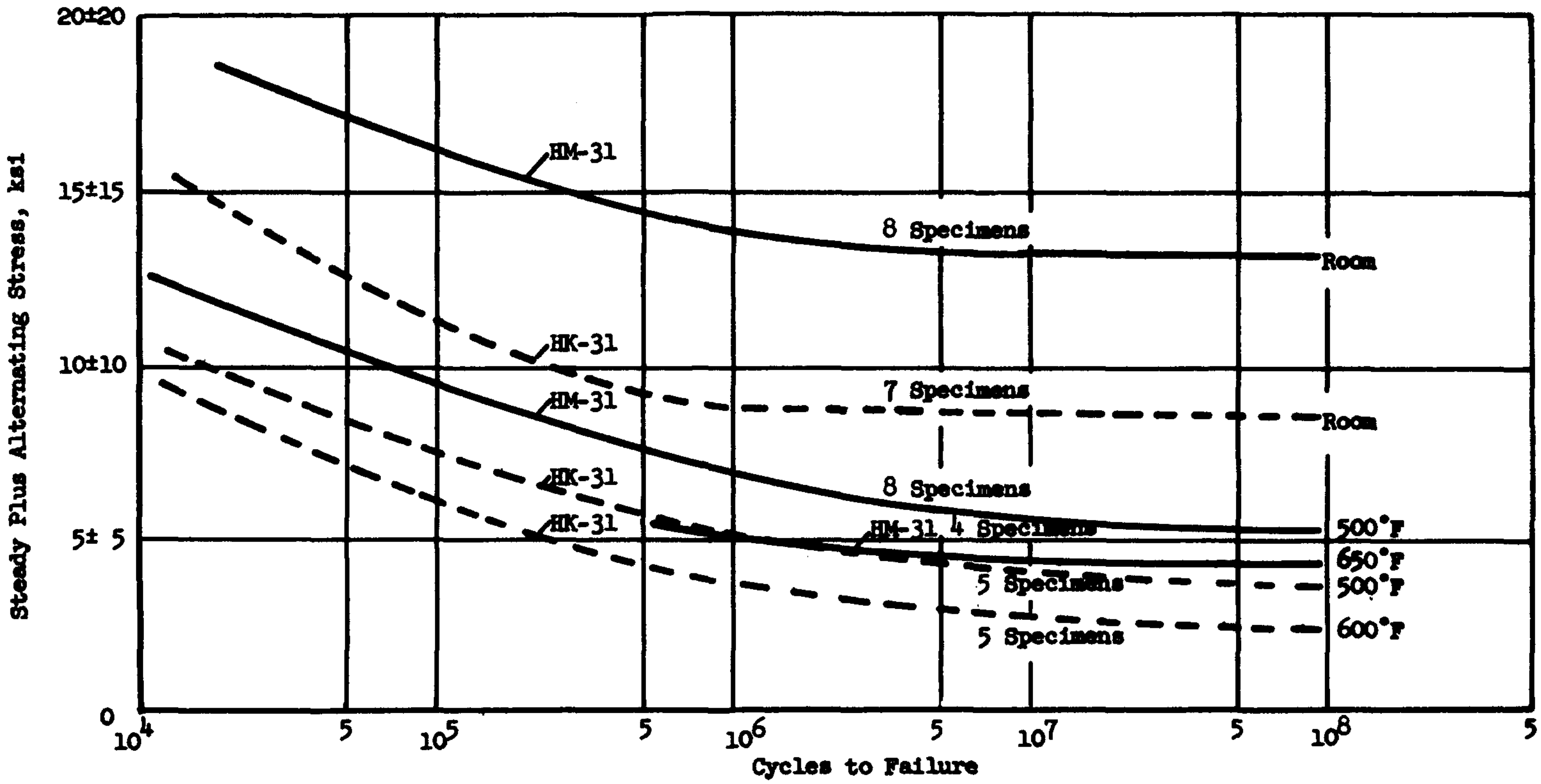

Fig. 142

S-N Curves for Smooth Specimens of Magnesium Alloys HM-31 and HK-31 at Room Temperature and at 500°, 600°, and 650°F, With Steady Loads (A = 1.0)

(From Ref. 69)

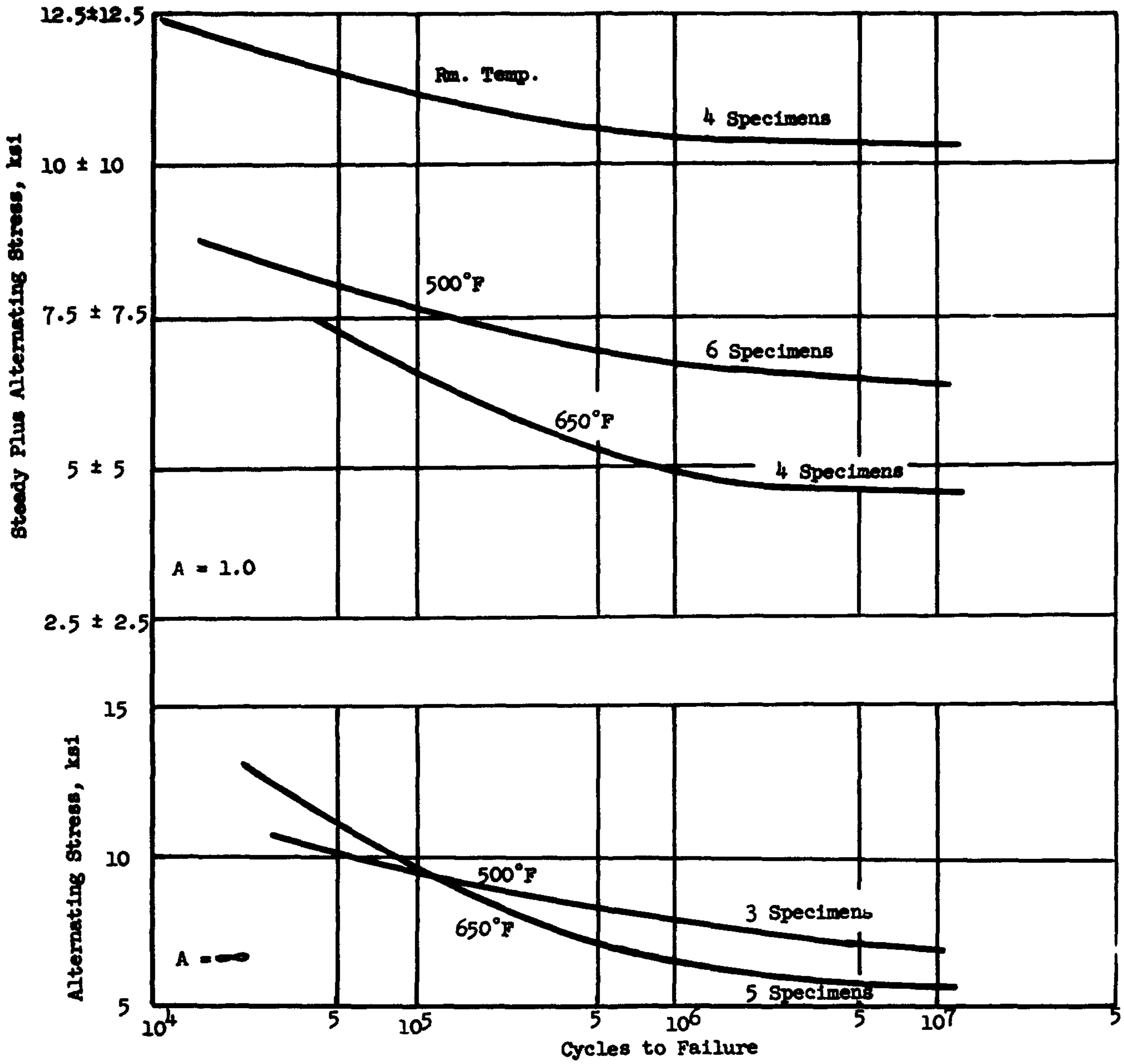

Fig. 143

S-N Curves for Smooth Specimens of Magnesium Alloy HM-21 at Room Temperature and at 500° and 650°F, With Steady Loads (A = 1.0) and Without Steady Loads (A = ∞)

(From Ref. 70)

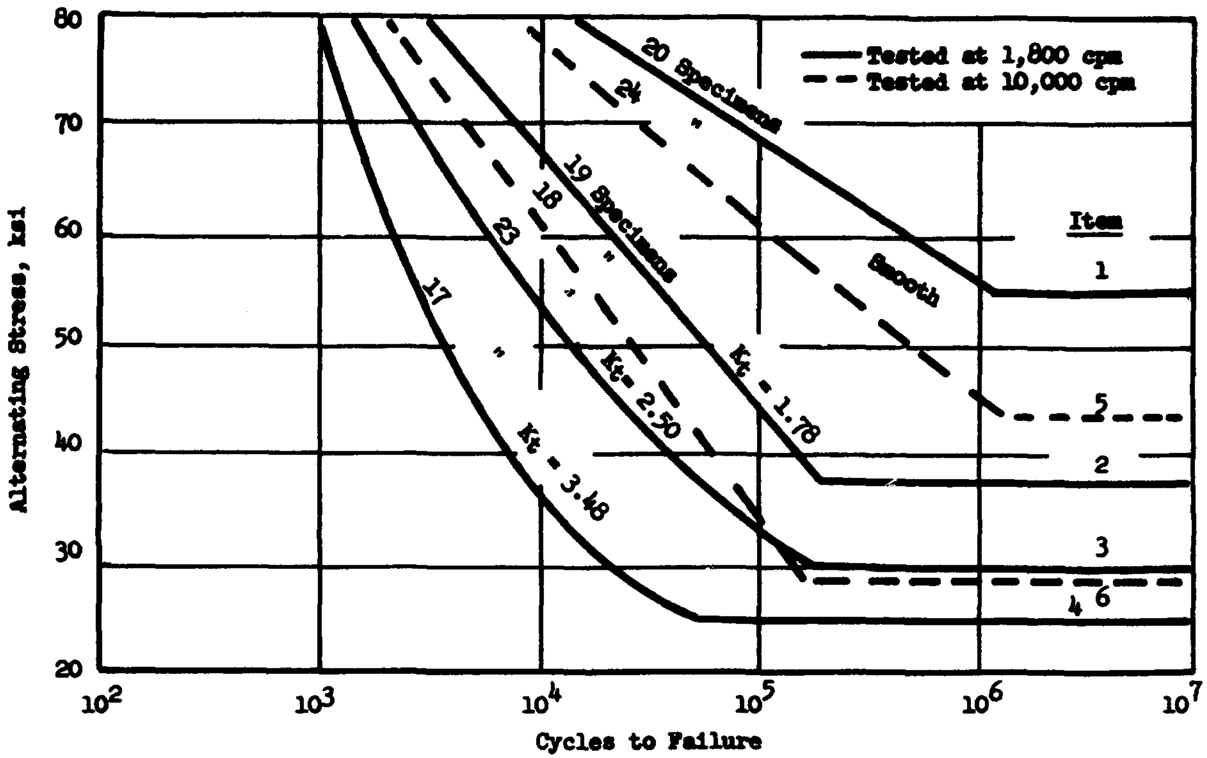

Fig. 144

S-N Curves for Smooth and Notched Specimens of Titanium Alloy, RC 55 Type

(From ref. 71)

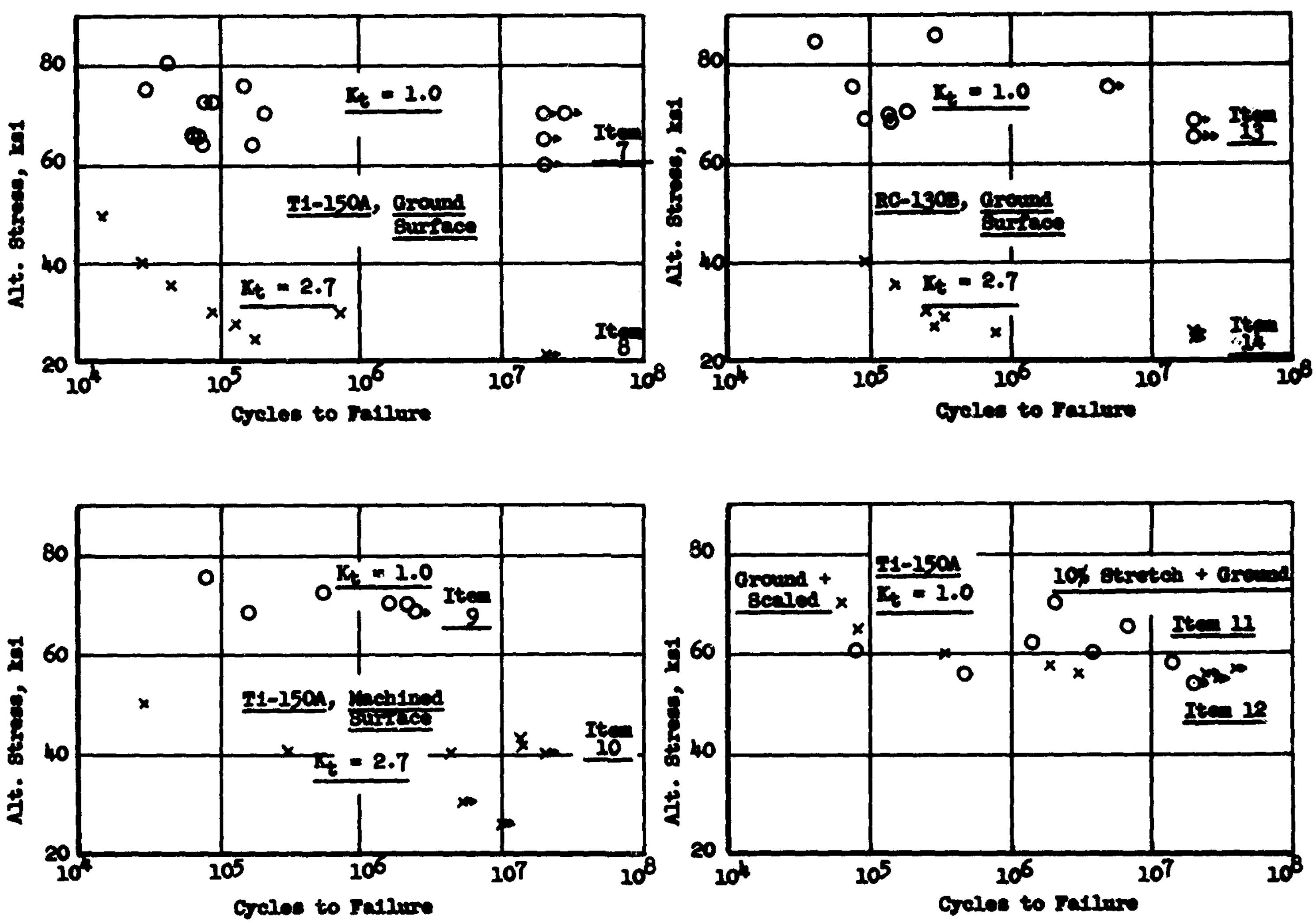

Fig. 145

S-N Plot of Fatigue Tests of Titanium Alloys Ti-150A and RC-130B

(From Ref. 72)

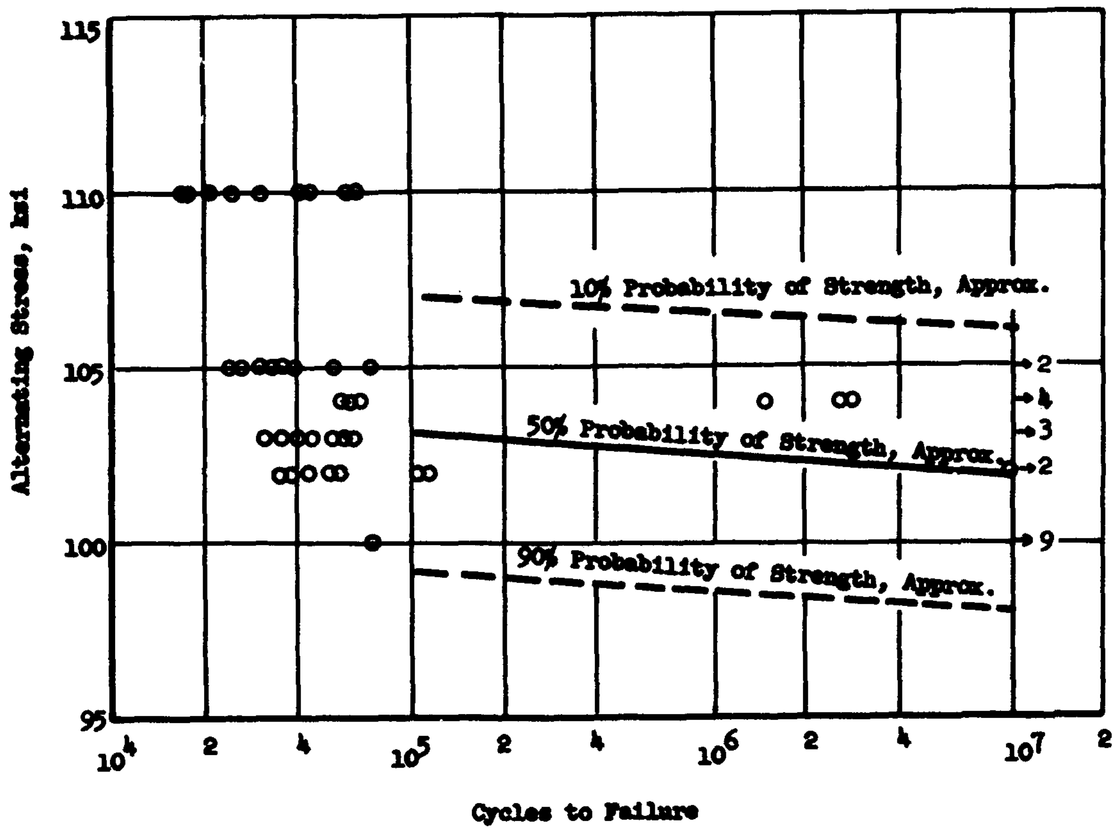

Fig. 146

S-N Curves for Titanium Alloy RC-130B

(From Ref. 73)

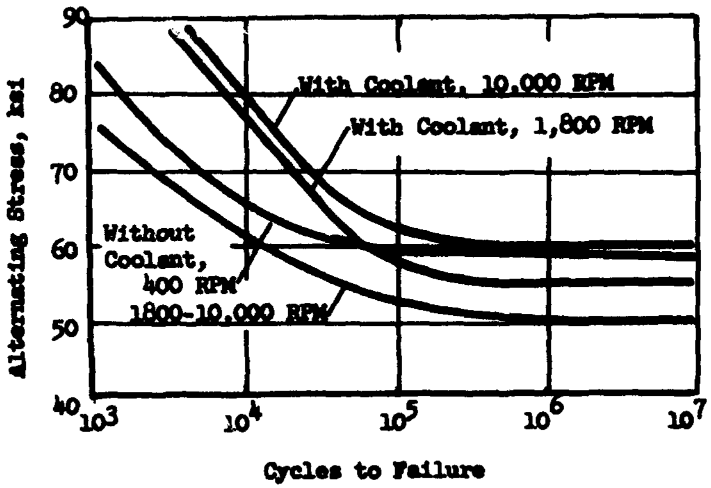

Fig. 147

S-N Diagrams for Ti-75A Titanium Alloy Tested at Different Speeds With and Without Coolant

(From ref. 76)

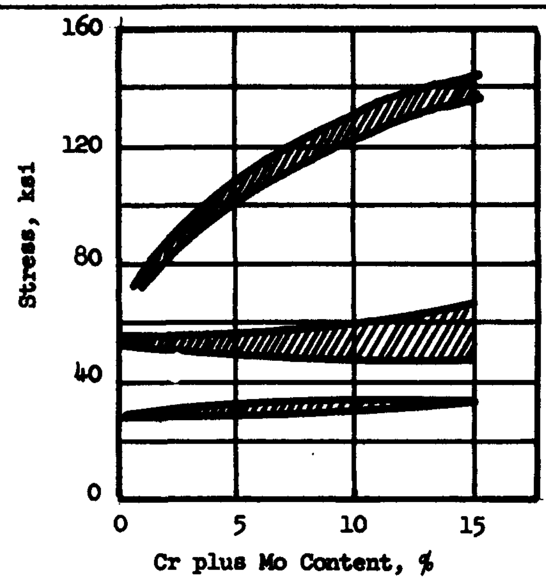

Fig. 148

Effect of Alloy Content on the Fatigue Properties of Ti-Cr-Mo Alloys

(From Ref. 77)

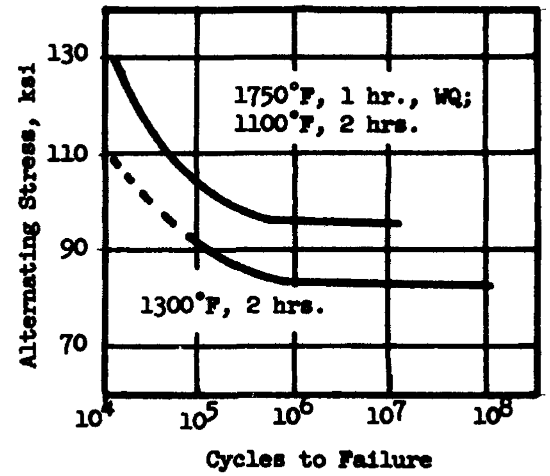

Fig. 149

S-N Curves for 6 Al-4 Va Titanium Alloys, For Two Heat Treatments

(From Ref. 78)

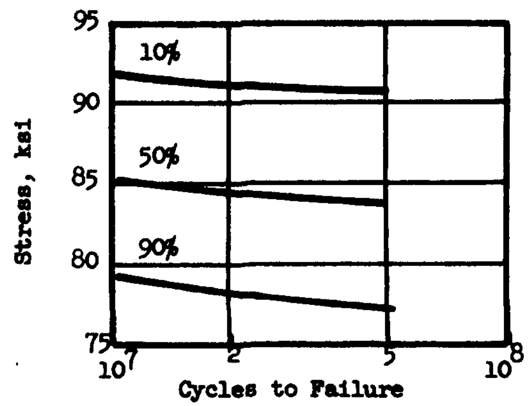

Fig. 150

S-N Curves for 6 Al-4 Va Titanium Alloy - Constant Probability of Survival of Stress at Constant Life

(From Ref. 29)

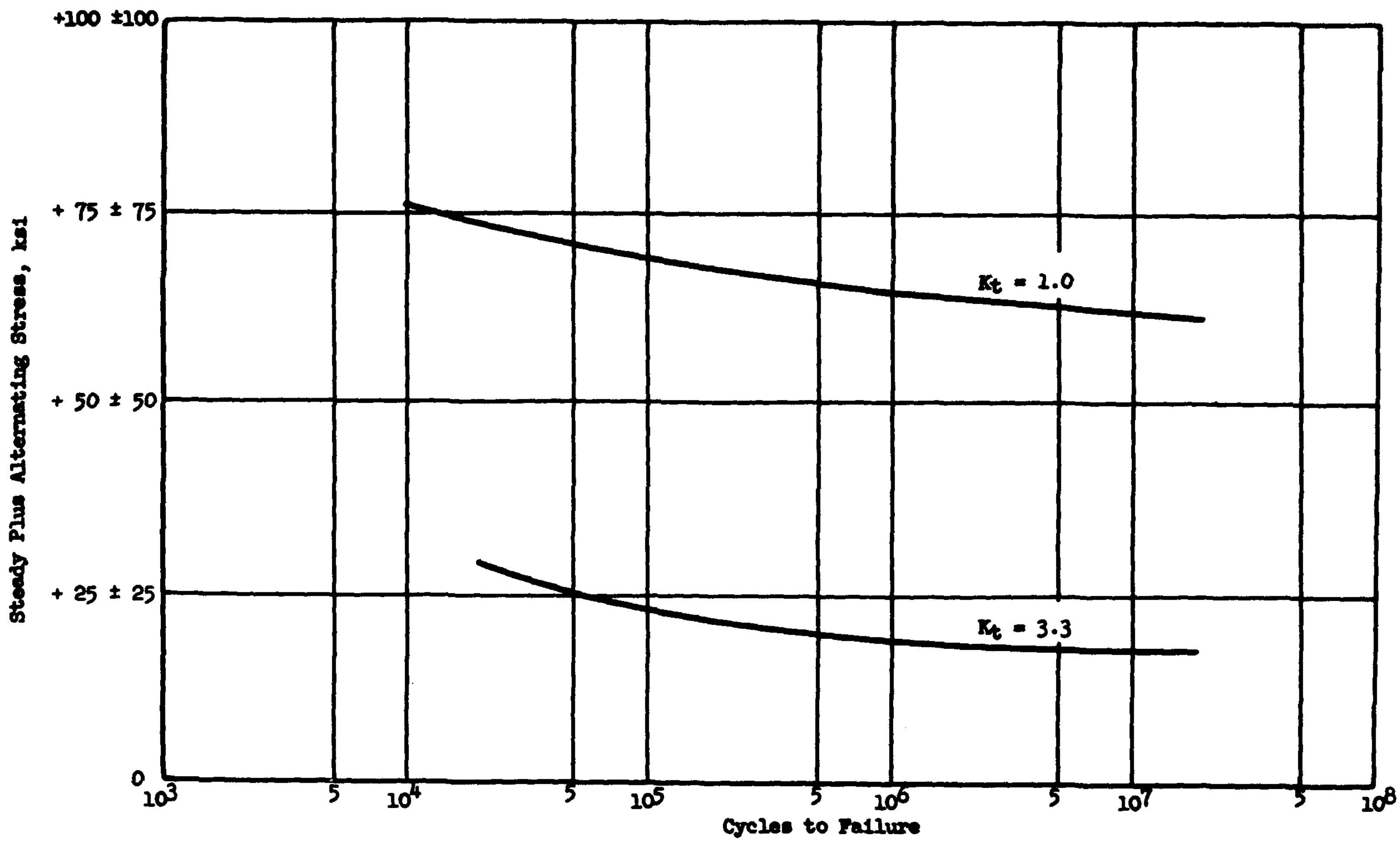

Fig. 151

S-N Curves for 6 Al-4 V Titanium Alloy Bar, Heat Treated to 160 ksi Minimum UTS

(From Ref. 38)

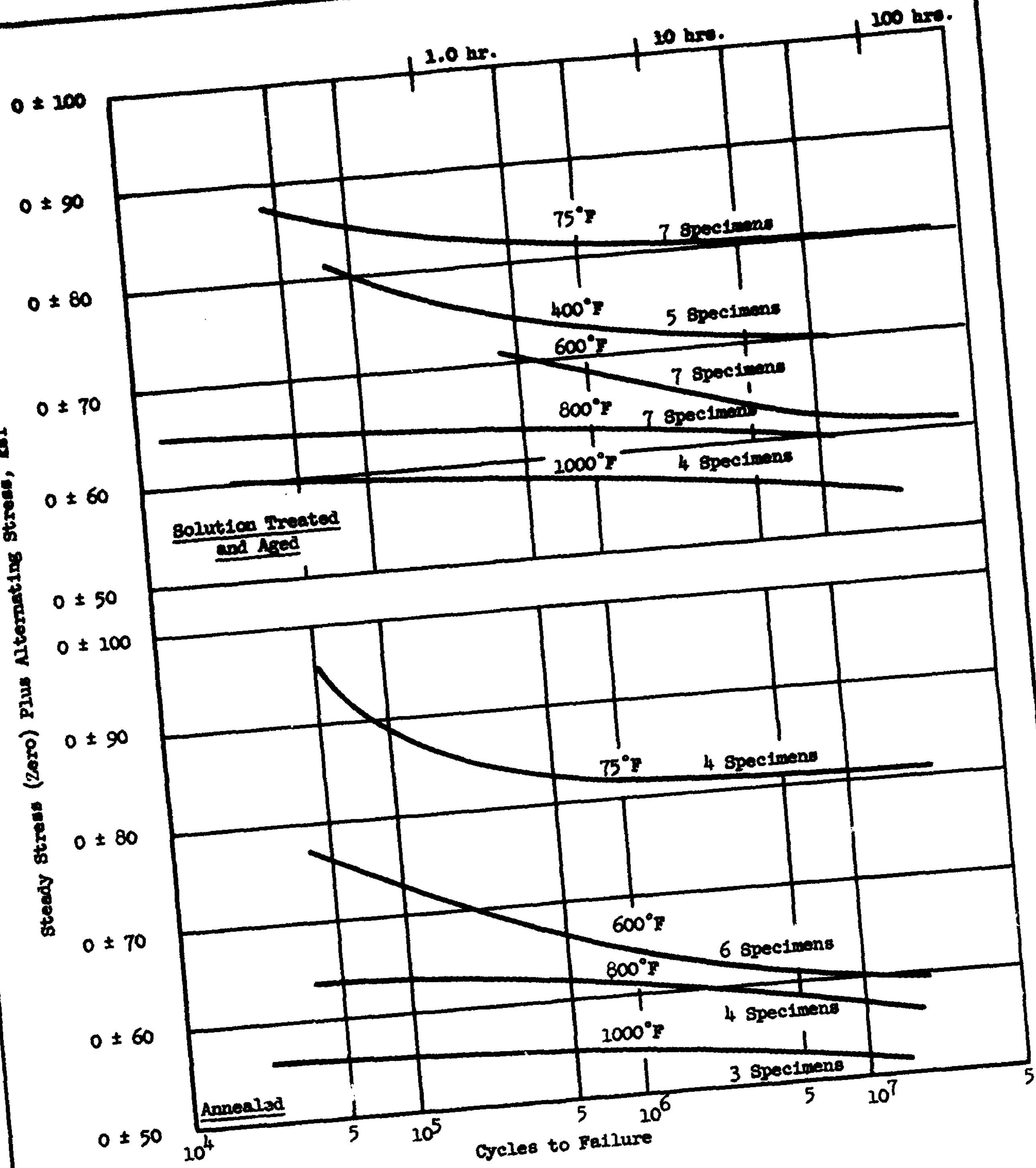

Fig. 152

S-N Curves for Aged, and Annealed, Smooth 7 Al-3 Mo Titanium Alloy, at 75°, 400°, 600°, 800°, and 1000°F, with Zero Steady Load ($A = \infty$)

(From Ref. 79)

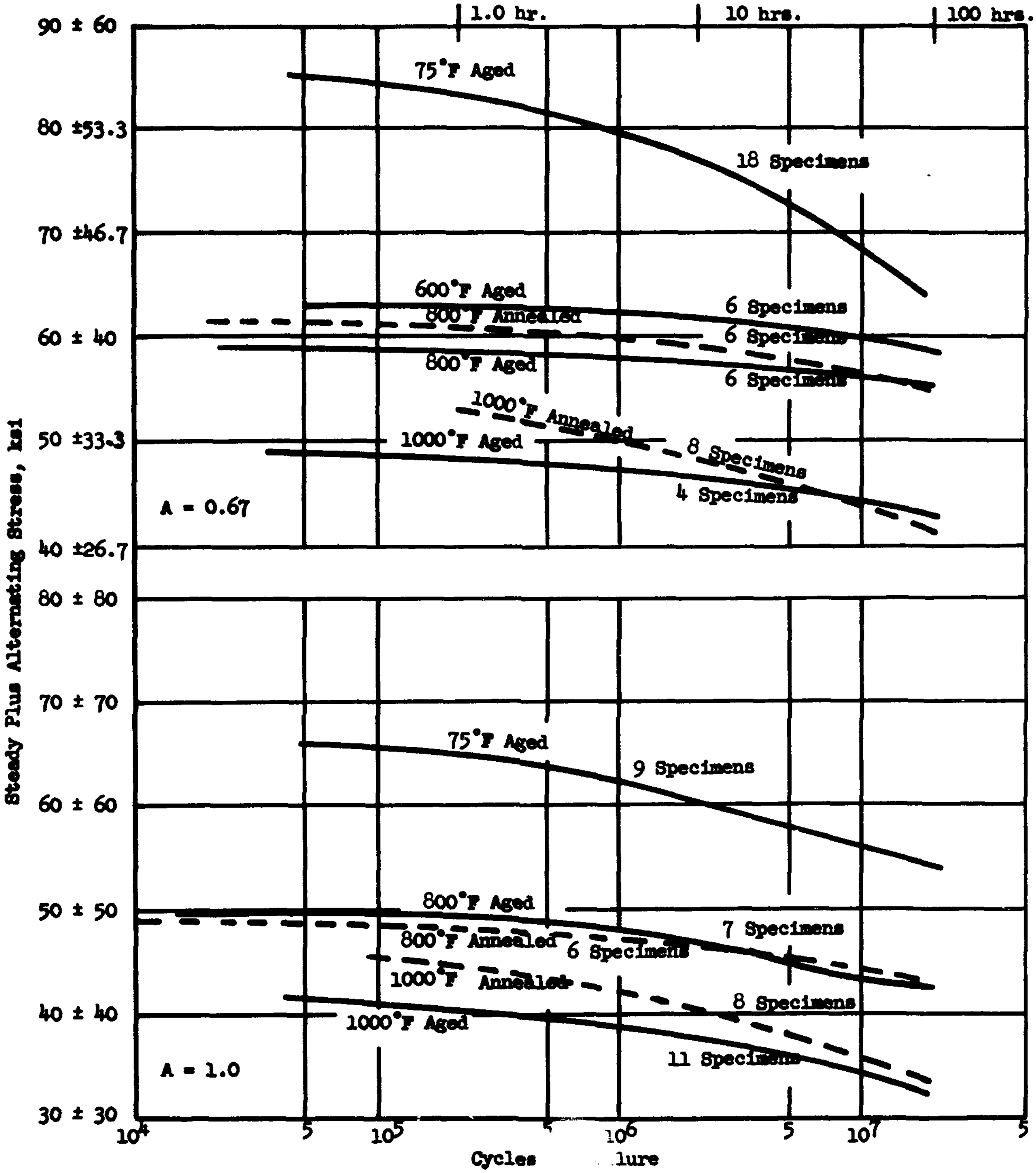

Fig. 153

S-N Curves for Aged, and Annealed, Smooth 7 Al-3 Mo Titanium Alloy at 75°, 400°, 800°, and 1000°F, With Steady Loads (A = 0.67 and 1.0)

(From Ref. 79)

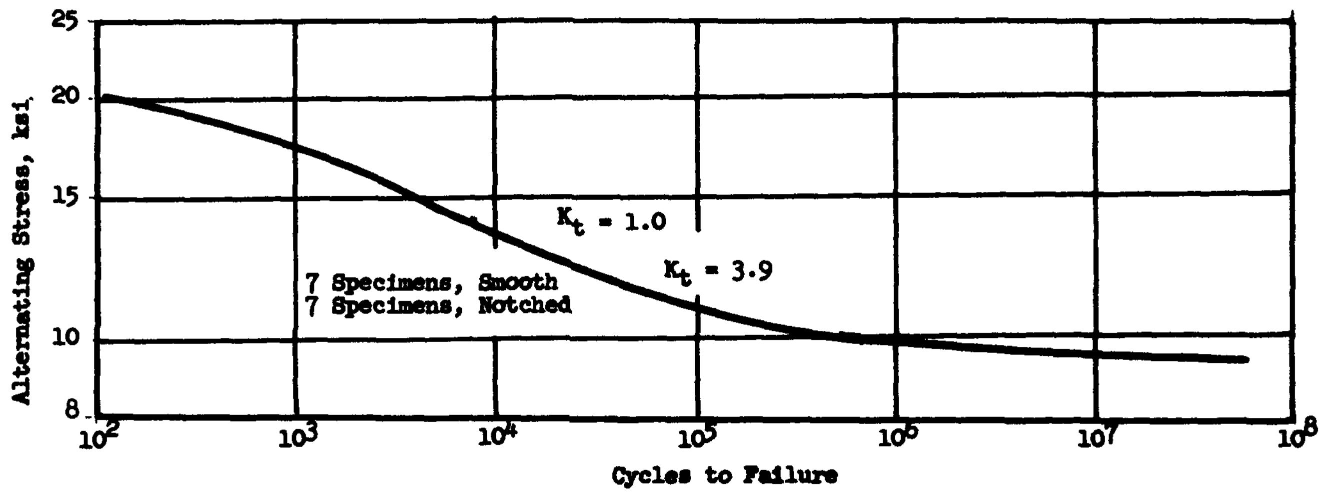

Fig. 154

S-N Curve for Both Smooth and Notched Gray Iron

(From Ref. 4)

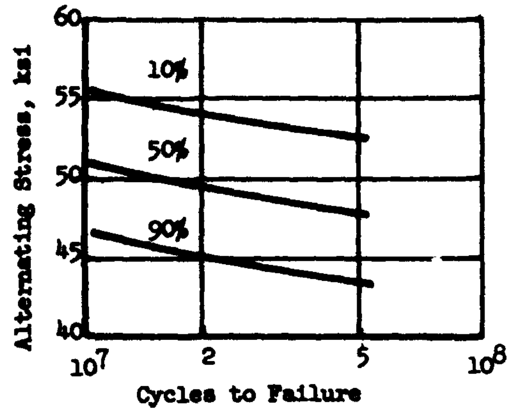

Fig. 155

S-N Curves of Constant Probability of Survival of Stress at Constant Life. R. R. Moore Tests of Al-Ni Bronze

(From Ref. 29)

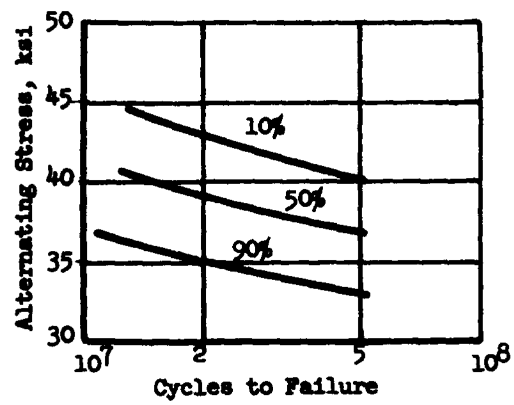

Fig. 156

S-N Curves of Constant Probability of Survival of Stress at Constant Life. R. R. Moore Tests of Beryllium Copper

(From Ref. 29)

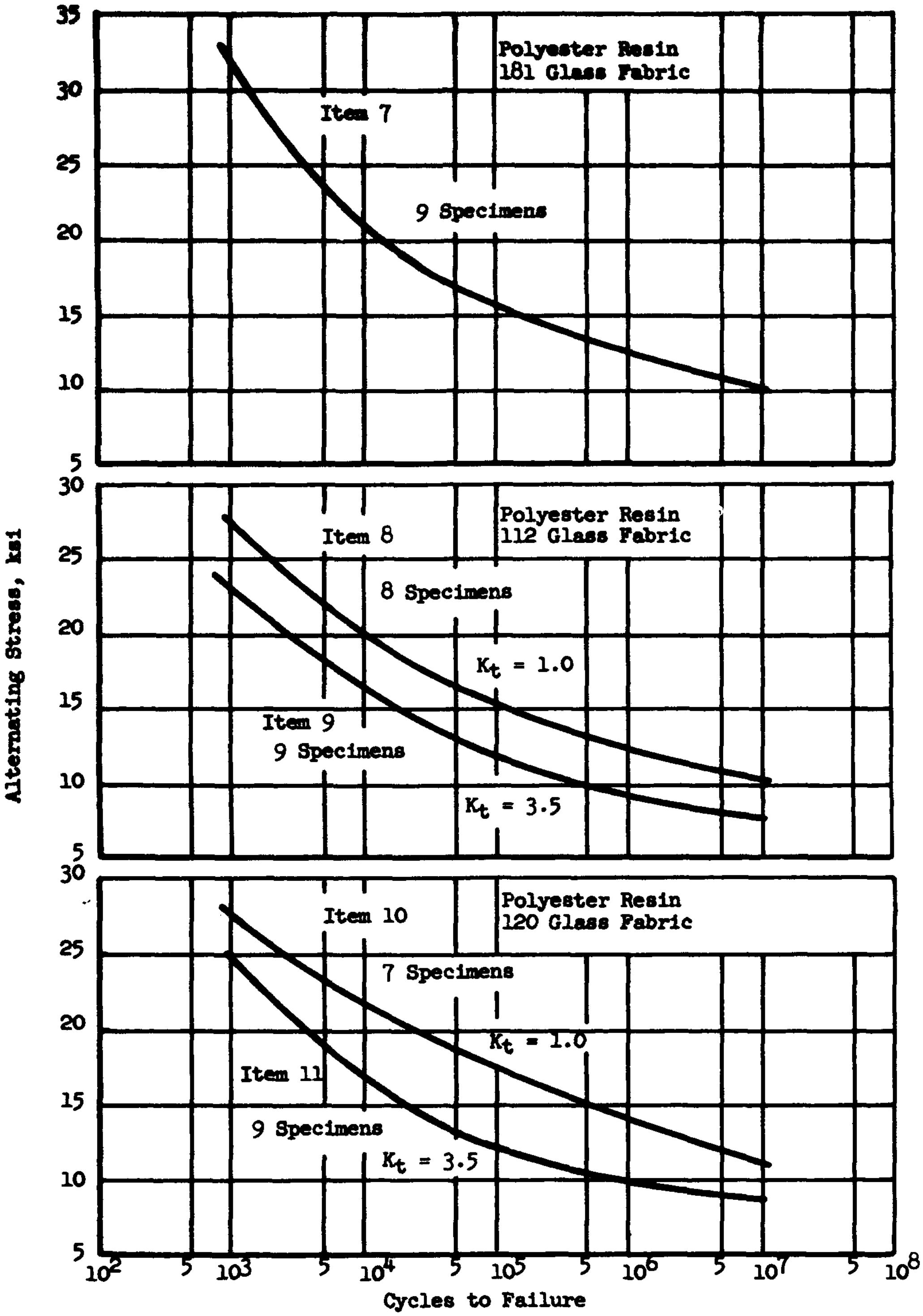

Fig. 157

S-N Curves for Glass-Fiber-Reinforced Plastic Laminates

(From Ref. 80)

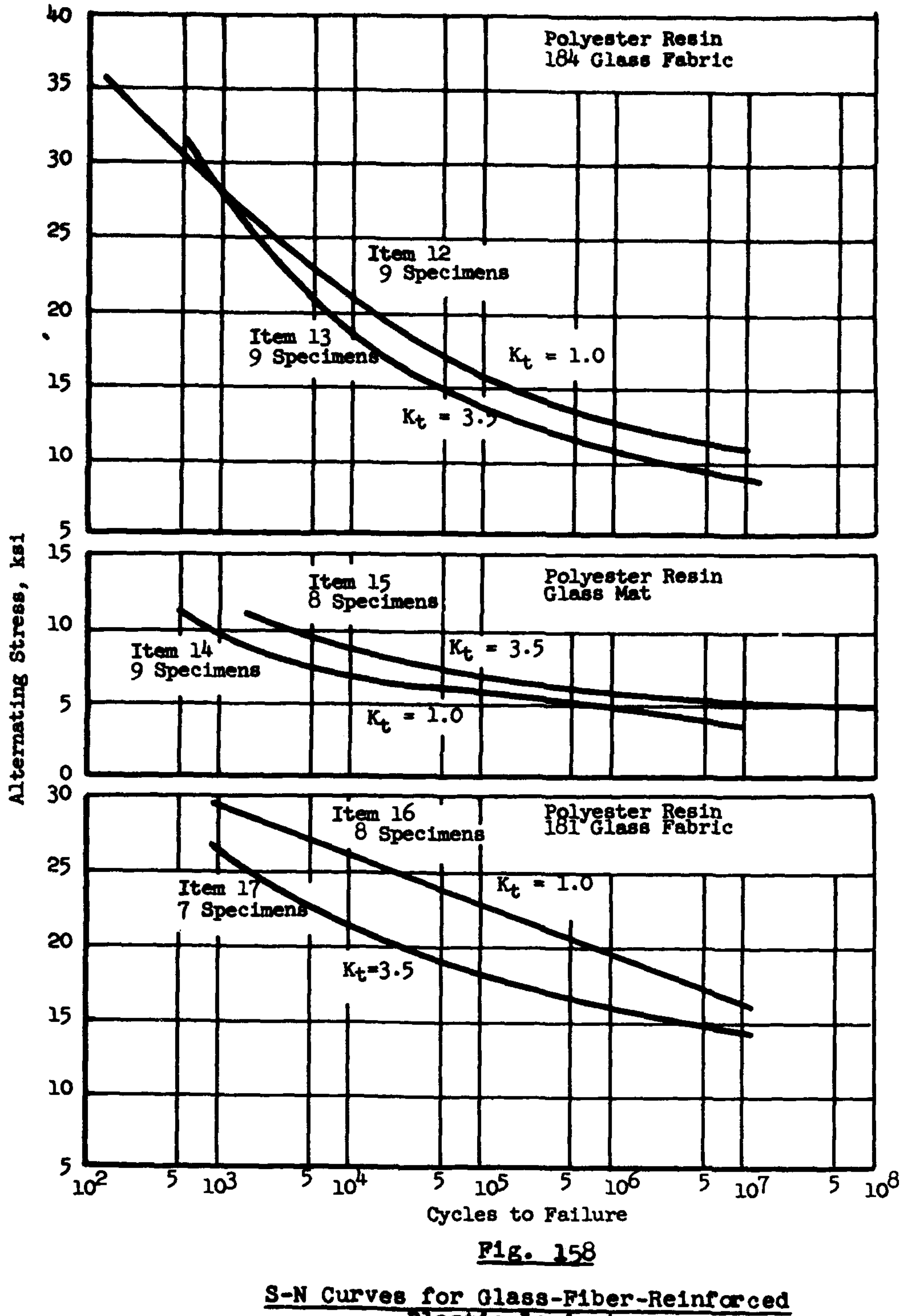

Fig. 158

S-N Curves for Glass-Fiber-Reinforced Plastic Laminates

(From Ref. 80)

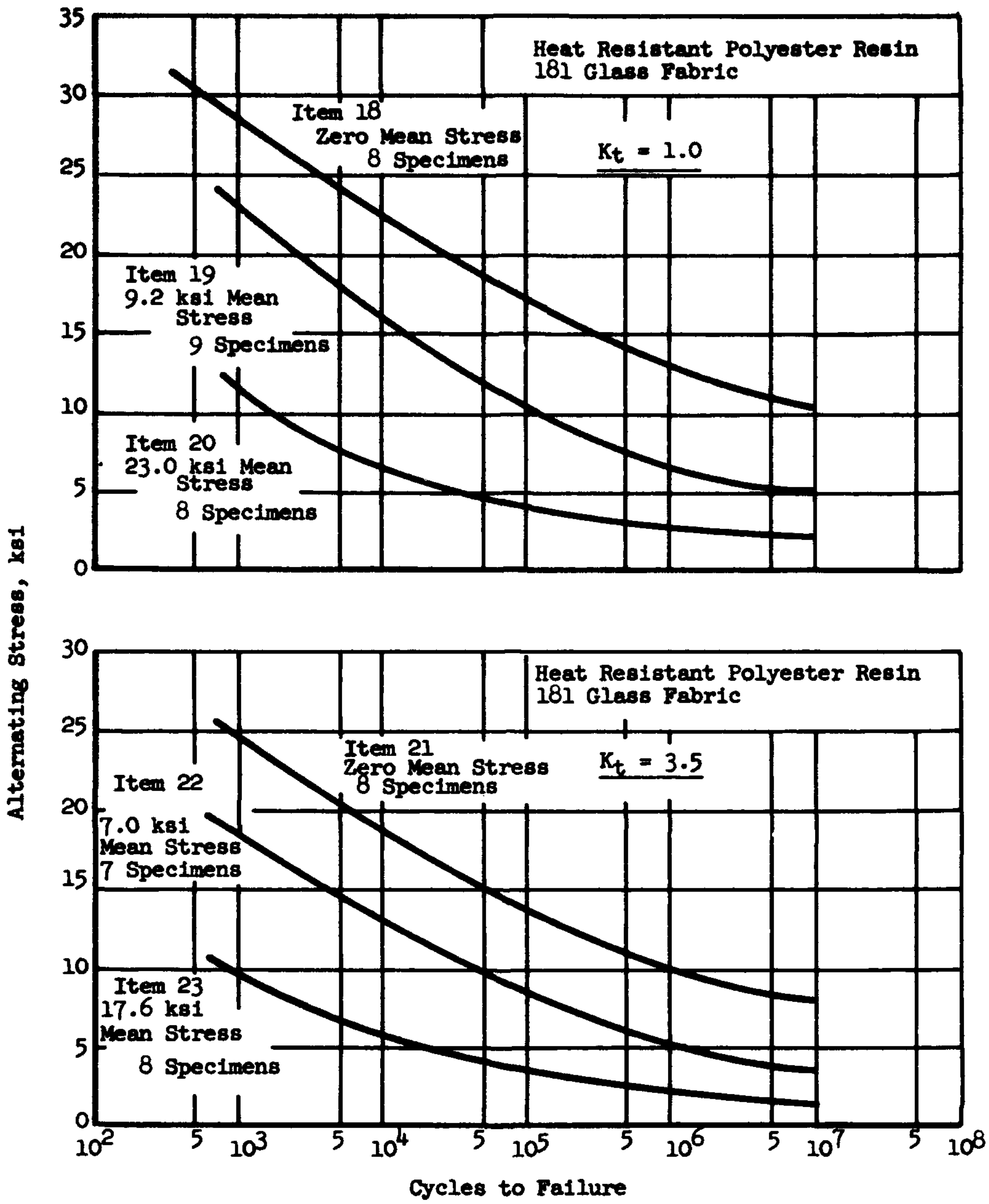

Fig. 159

S-N Curves for a Heat Resistant Glass-Fiber-Reinforced Plastic Laminate, With and Without Superimposed Mean Stress

(From Ref. 80)

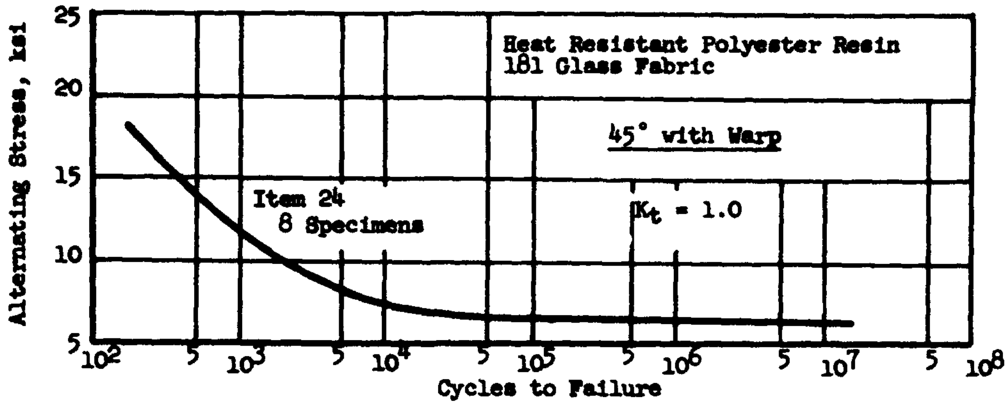

Fig. 160

S-N Curves of a Heat Resistant Glass-Fabric Reinforced Plastic Laminate, at 45° with the Warp

(From Ref. 80)

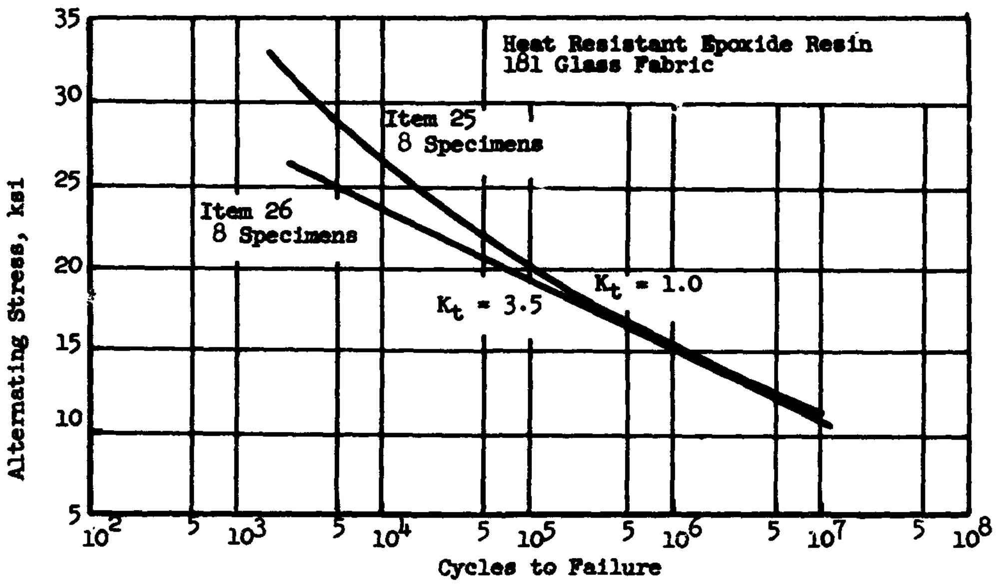

Fig. 161

S-N Curves for a Heat Resistant Glass-Fabric-Reinforced Plastic Laminate

(From Ref. 80)

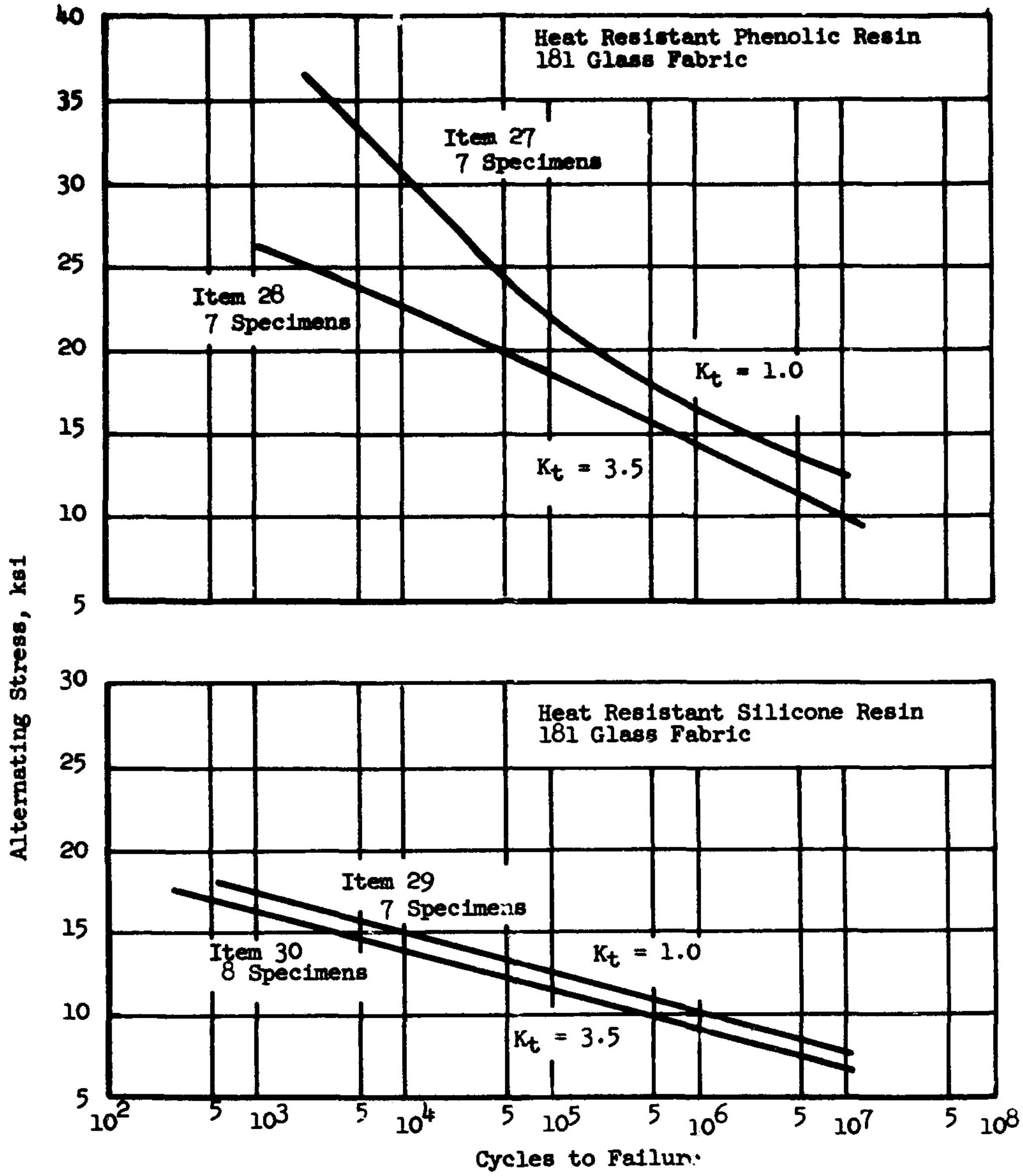

Fig. 162

S-N Curves of Heat Resistant Glass-Fabric Reinforced Plastic Laminates

(From Ref. 80)

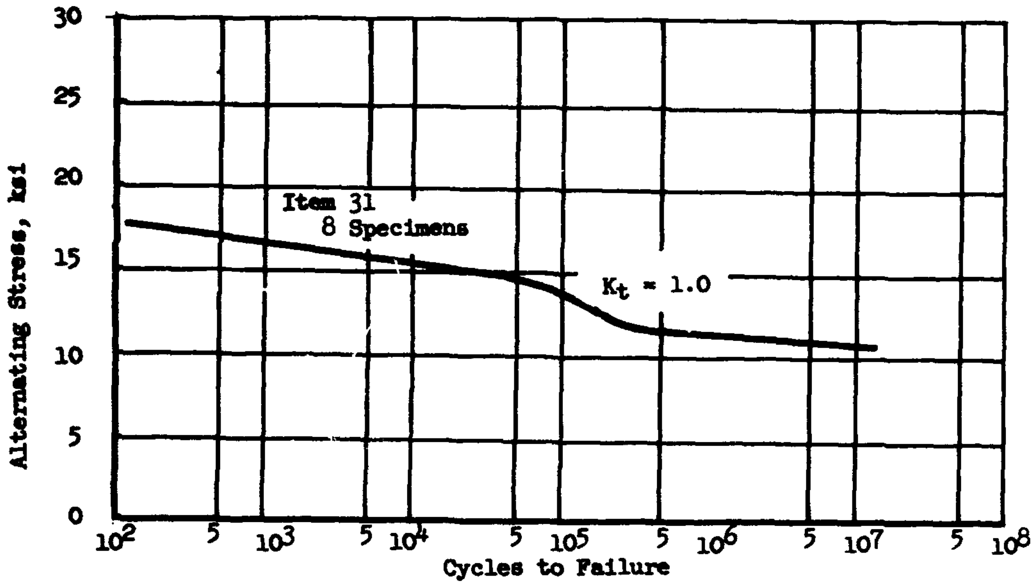

Fig. 163

S-N Curves for a Glass Fabric Laminate Plastic

(Plotted from Table XI of Ref. 42)

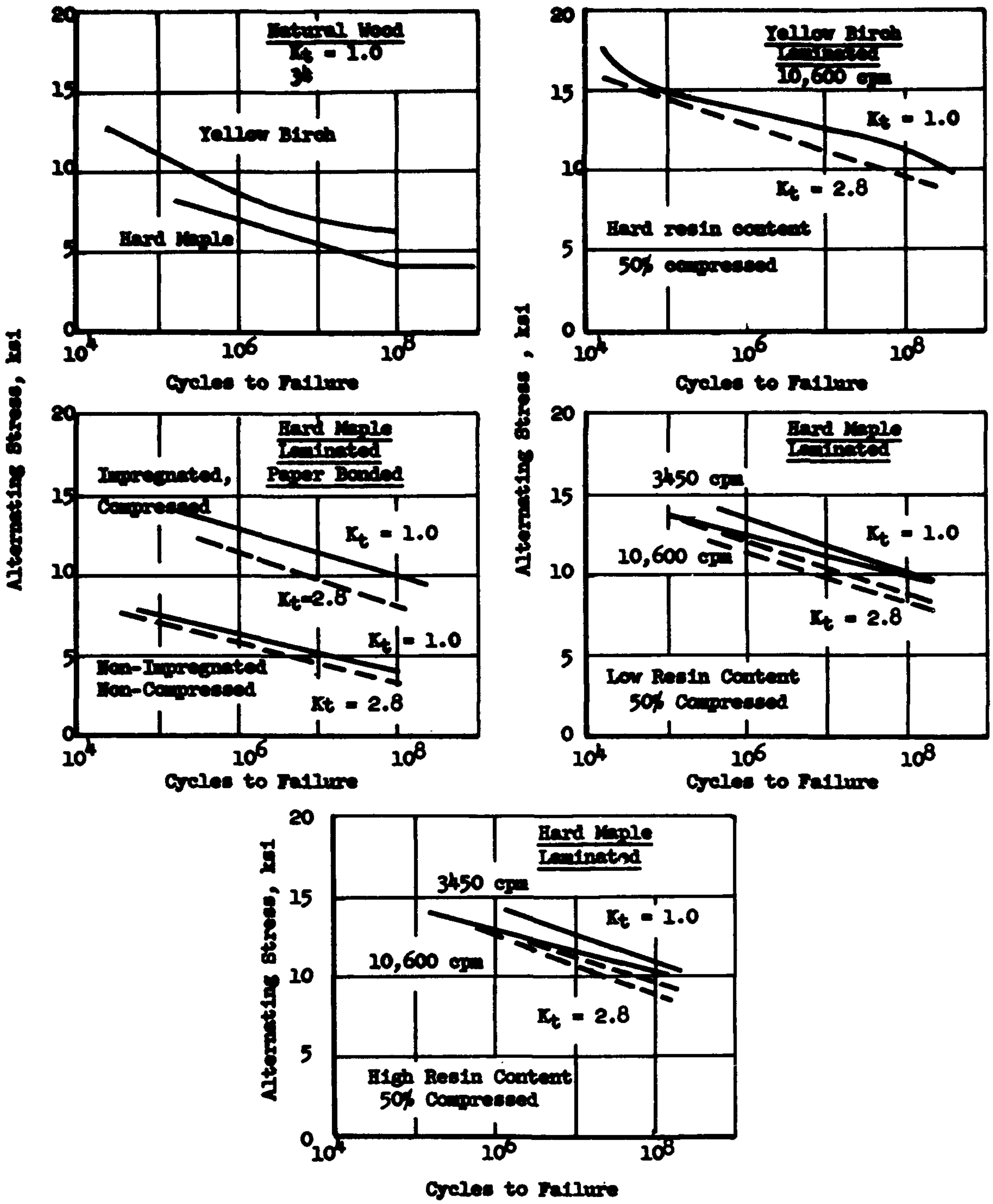

Fig. 164

S-N Curves for Natural and Laminated Wood

(From Ref. 81)

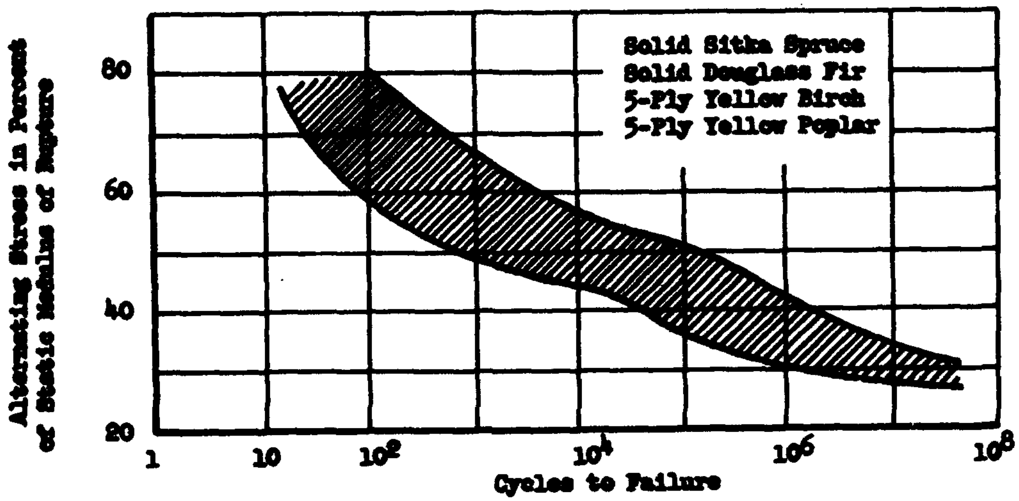

Fig. 165

Approximate S-N Scatter Band for 200± Specimens of Natural and Laminated Wood

(From Ref. 82)

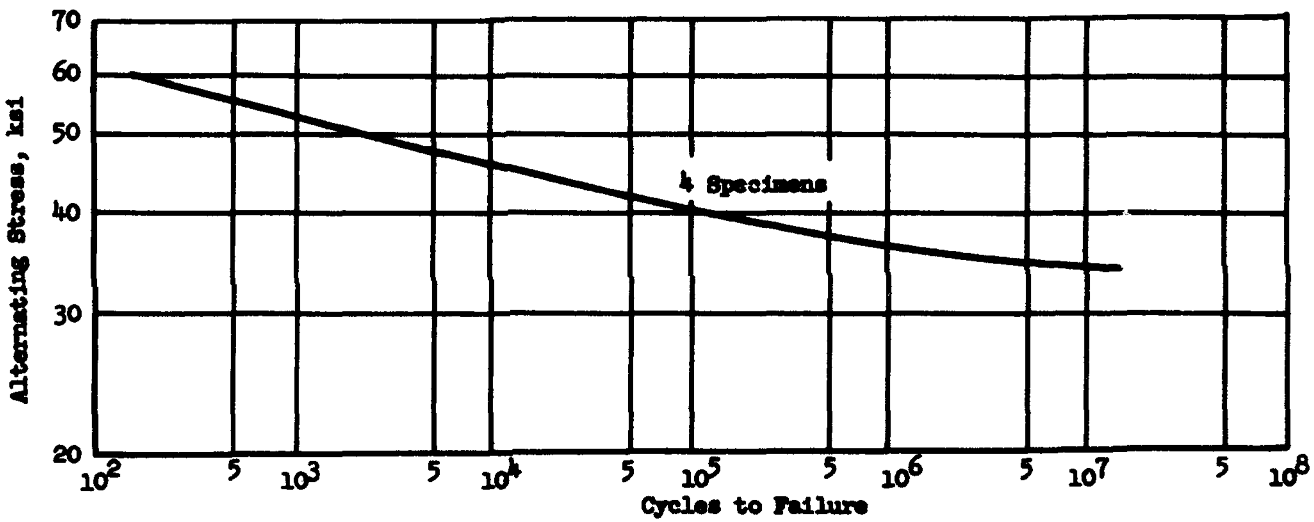

Fig. 166

S-N Curve for Brush QMV Beryllium.
Smooth Specimens. Rotating Bending Tests.

(From Ref. 83)

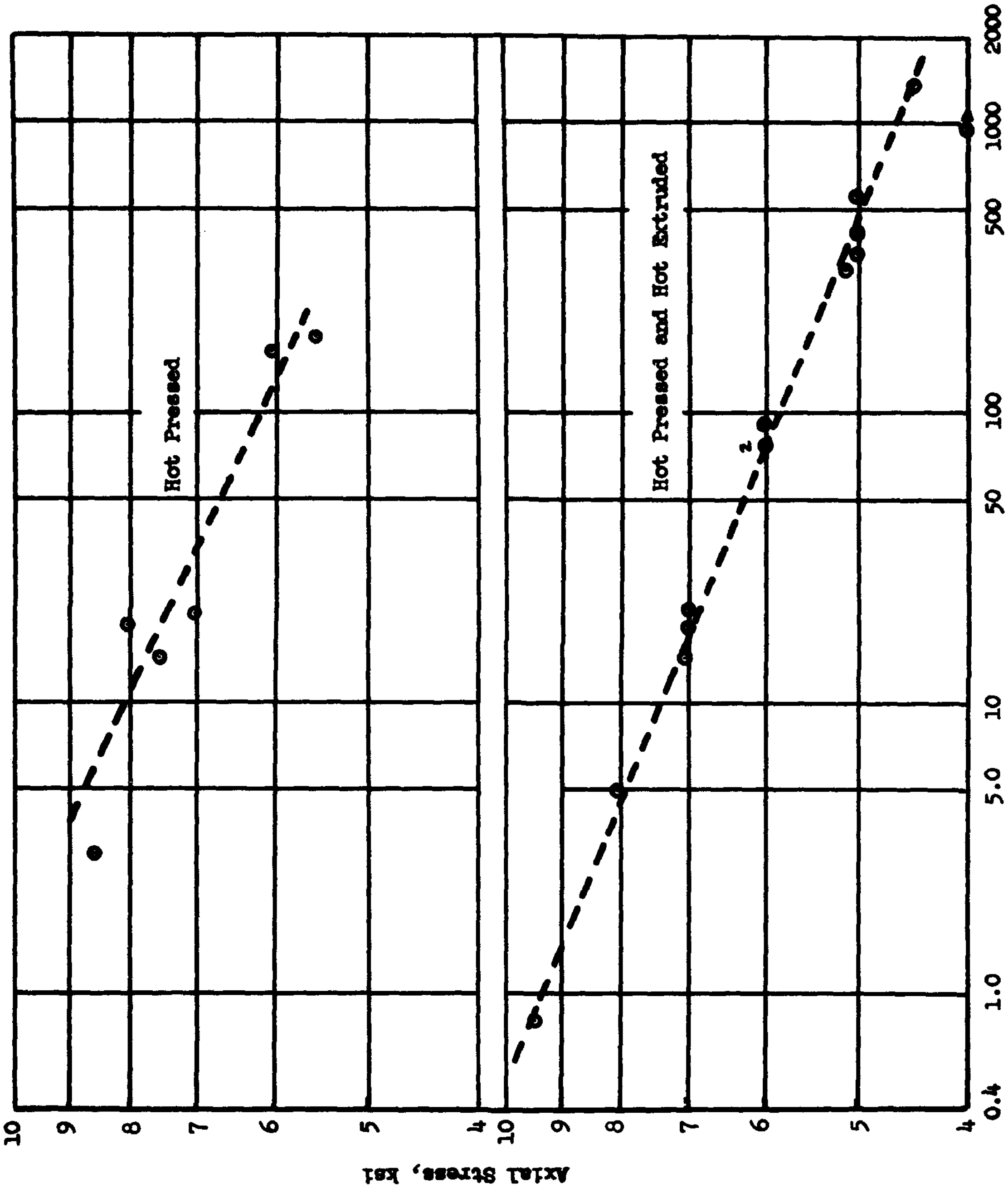

Fig. 167

Stress-Rupture Curves for QMV Beryllium at 1100°F.

(Plotted from Ref. 84)

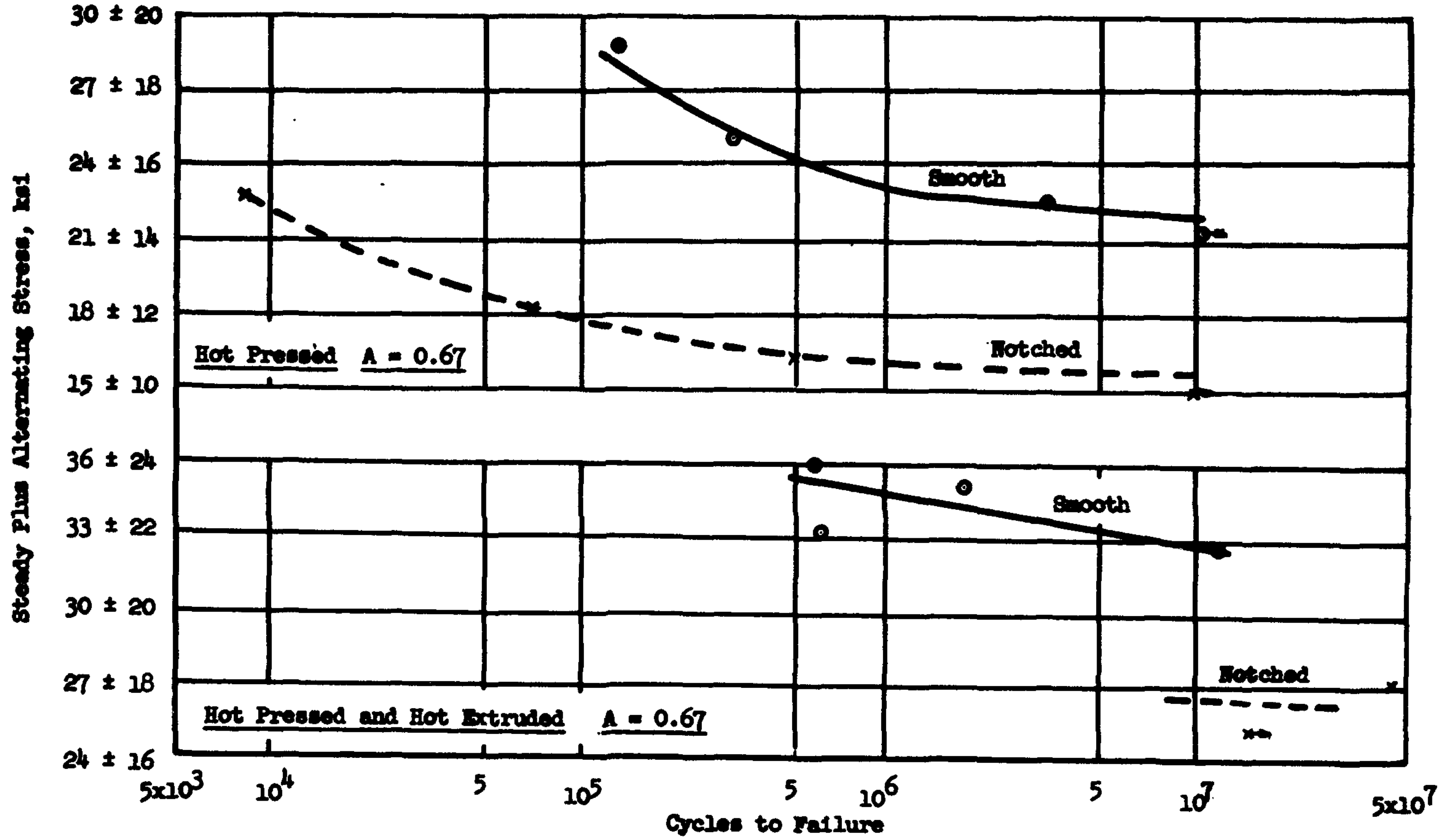

Fig. 168

Approximate S-N Curves for Beryllium, Smooth and Notched. Steady Plus Alternating Stress, at Room Temperature.

(Plotted from Ref. 85)

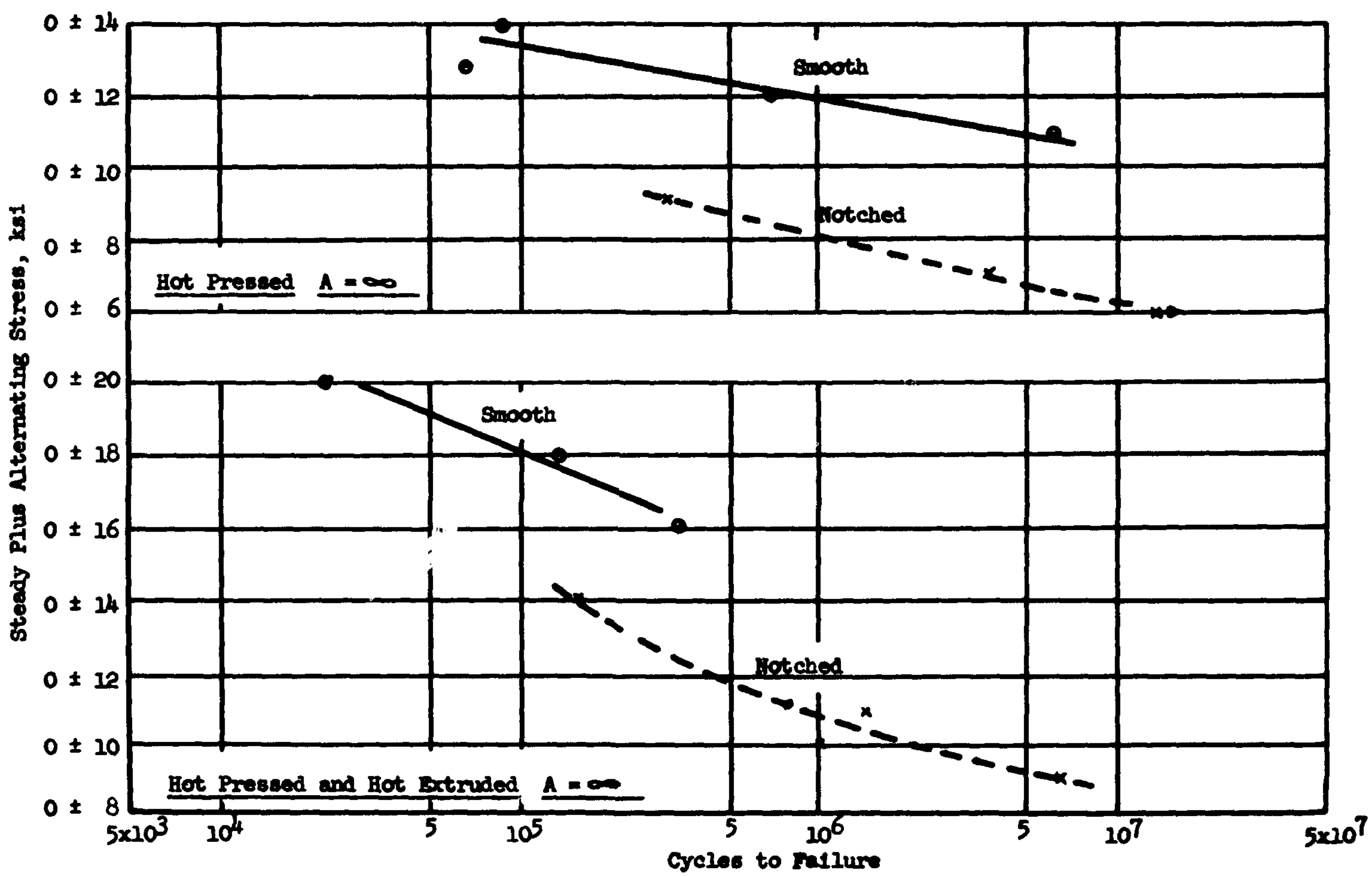

Fig. 169

Approximate S-N Curves for Beryllium, Smooth and Notched. Alternating Stresses Only, at 1100°F.

(Plotted from Ref. 85)

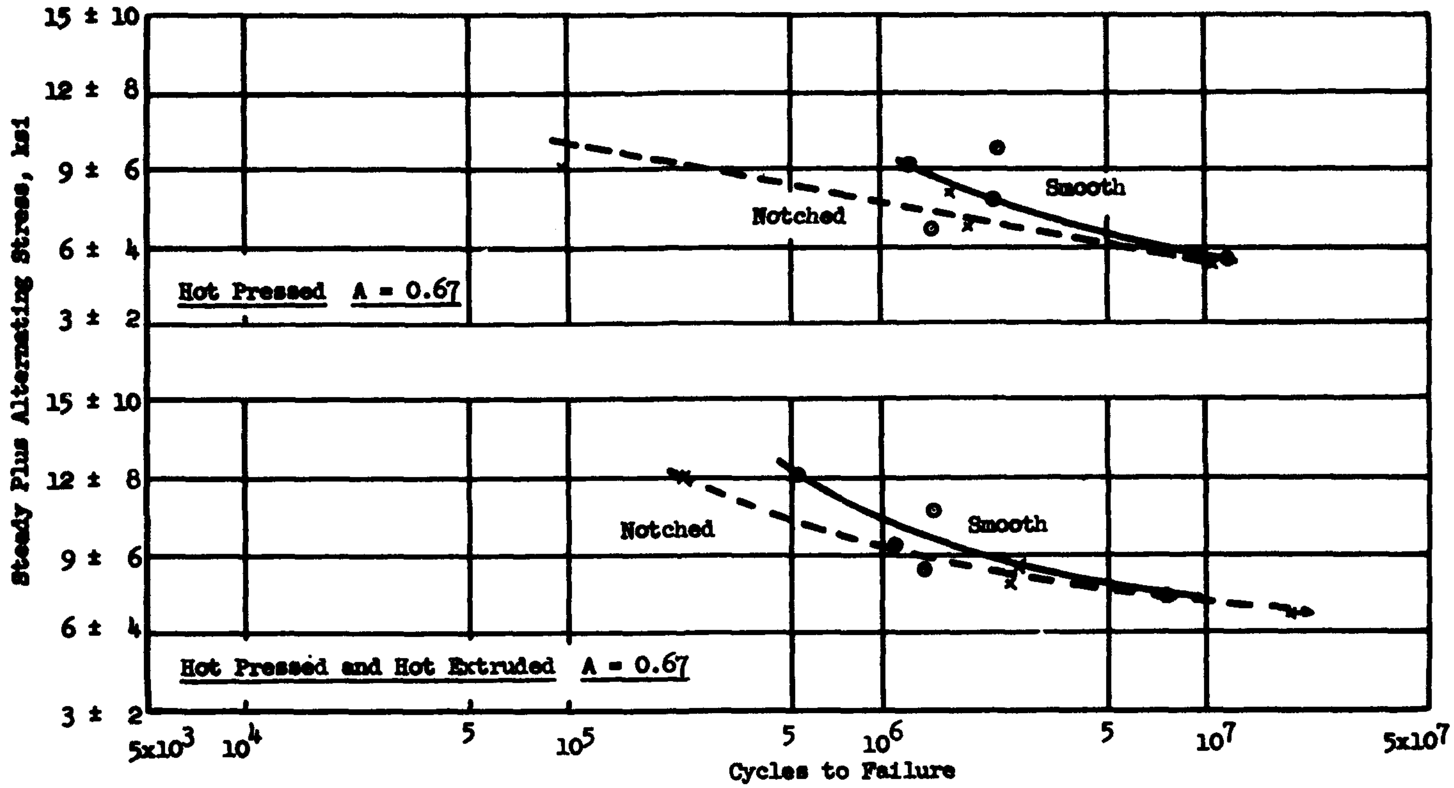

Fig. 170

Approximate S-N Curves for Beryllium, Smooth and Notched.
Steady plus Alternating Stress, at 1100°F.

(Plotted from Ref. 85)

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LIST OF AUTHORS OF REFERENCES

LIST OF MATERIALS

MATERIAL	TABLE	ITEMS	PARAGRAPH	FIGS.
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1330	"	14-19	"	---
1340	"	20-23	"	---
2315	"	24-33	"	8-10
2330	"	34-37	"	11-12
2340	"	38-39	"	13
4130	"	40-44	"	14-15
4135	"	45-48	"	---
4140	"	49-52	"	---
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Unclassified report

In this report are given not only the fatigue properties of many structural materials but also the "static"properties and such other supplementary information as was given in the references consulted. The data is in general from room temperature tests, but some is given on tests at higher temperatures. The data is presented in tables and on curves, supplemented by brief discussions in the text.

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